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This above all: to thine own self be true,
And it must follow, as the night the day,
Thou canst not then be false to any man.

HAMLET - ACT I, SC. 3

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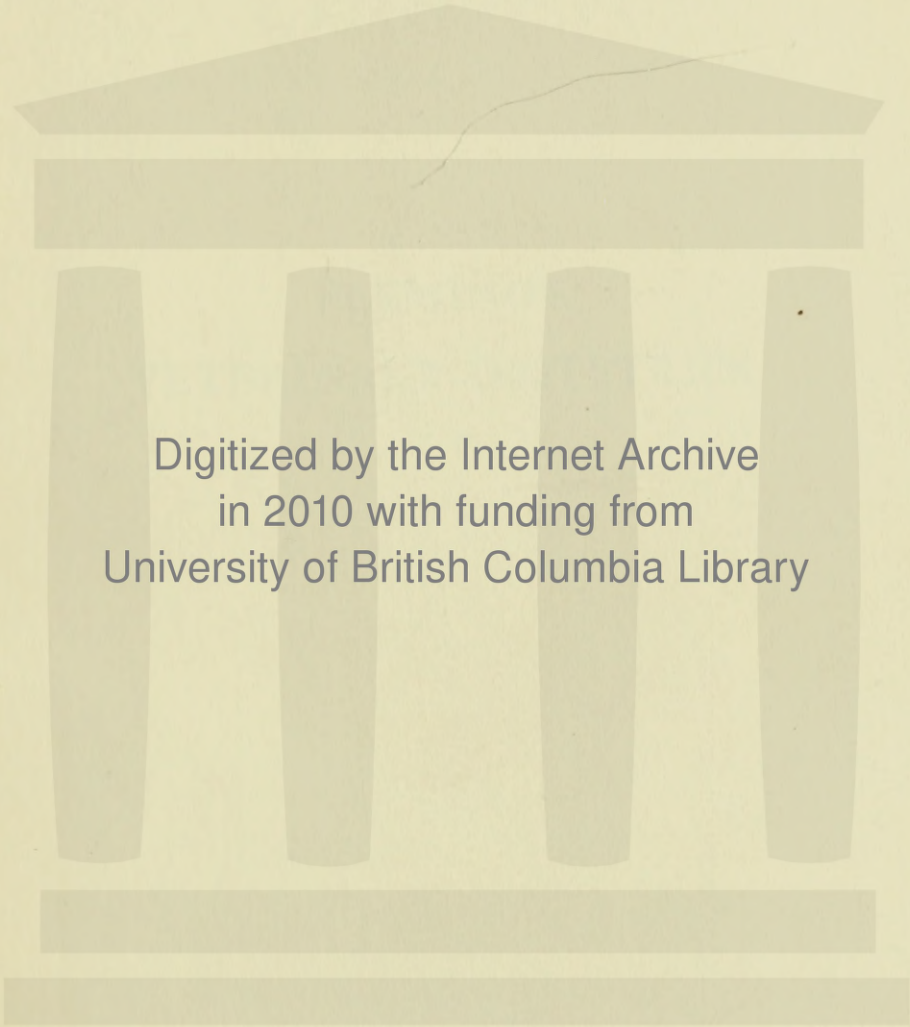

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FLEMING'S
VETERINARY OBSTETRICS

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FLEMING'S

VETERINARY OBSTETRICS

INCLUDING THE DISEASES AND ACCIDENTS INCIDENTAL TO PREGNANCY AND PARTURITION

FOURTH EDITION

REVISED BY

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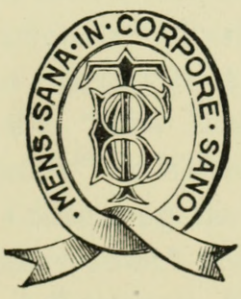

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PREFACE

In the preparation of the fourth edition of Fleming's "Veterinary Obstetrics," the general form and scope of the third edition has been adhered to and the matter brought up to date.

The sections on Contagious Abortion and Sterility have been rewritten and enlarged, and a short account given of the modern views on these subjects and their treatment.

The more recent theories regarding the causation of Milk Fever have received attention.

Among the additional subjects dealt with in this edition may be mentioned Pregnancy Disease of Ewes and Acetonæmia of Cattle.

Reference is made in the appropriate places to any new instruments of value in veterinary obstetrics.

The literature consulted includes works on Veterinary Obstetrics by Williams, De Bruin, etc.; Marshall's "Physiology of Reproduction"; Hammond's "Physiology of Reproduction in the Cow"; works on Sterility by Albrechtsen, Zschokke, Oppermann, and Wester; "The Diseases of the Genital Organs of Domestic Animals" by Williams; Folmer Neilsen's paper on "Researches Concerning the Etiology and Pathogenesis of Sterility in Dairy Cows," presented at the Dublin Congress of the National Veterinary Medical Association in 1926; and numerous articles in veterinary periodicals.

Although many changes have been made, the book has only been slightly enlarged, and may therefore continue to be regarded as a handy textbook for students of veterinary obstetrics.

My thanks are due to my colleague, Professor T. G. Browne, M.R.C.V.S., Professor of Anatomy, Veterinary College of Ireland, for the valuable assistance he has rendered in revising the section on Anatomy and the Index and in correcting proofs.

J. F. CRAIG.

DUBLIN,
January, 1930.

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A TEXT-BOOK

OF

VETERINARY OBSTETRICS

CHAPTER I

OBSTETRICAL ANATOMY

In this section it is necessary to describe the structures of the female involved in reproduction. These consist of the ovaries, Fallopian tubes, uterus, vagina, vulva, and mammary glands. And it is also essential that the pelvis should be considered, because it forms the cavity in which some of the female genital organs are contained, and through which the fœtus must pass in order to reach the outer world in the act of parturition. This passage is of very considerable importance to the obstetrician, on account of its rigid walls, and the consequent resistance which it presents to the passage of the fœtus as the result of any variation from the normal in the latter or its position.

THE PELVIS.

The Pelvis is the most posterior and smallest of three great cavities of the trunk. It is bilaterally symmetrical, and more or less horizontal in the domesticated animals. It is formed of bony and ligamentous walls, and contains, sustains, and protects a portion of the genito-urinary apparatus, as well as the terminal portion of the alimentary canal. It is situated towards the end of the spine, and is supported by the posterior extremities, with which it is connected by joints and muscles.

The pelvis is bounded at the sides and below by the two innominate bones (ossa innominata), and above by the sacrum

and first two or three coccygeal vertebræ. At the sides the cavity is completed by the sacro-sciatic ligament.

The *Os Innominatum*, or *Coxa*, is a paired bone which not only forms the chief boundary of the pelvis, but also the framework of the uppermost segment (haunch) of the hind limb, which it connects with the spine. At birth the coxa is formed of three bony elements, joined together by cartilage, known as the ilium, ischium, and pubis; but these portions soon fuse and meet in the acetabulum. In youth the different parts of each coxa are very thick, the spongy tissue being abundant, and the compact tissue scanty; as the animal

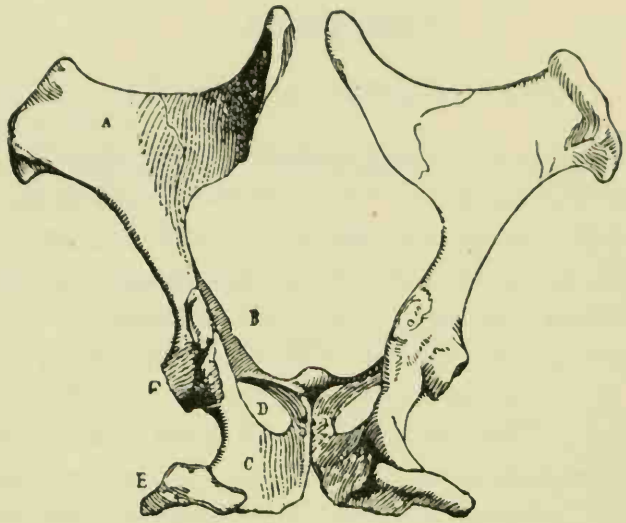

FIG. 1.—PELVIS OF THE MARE FROM BEHIND. (BAUMEISTER AND RUEFF.)

A, Ilium; B, pubis; C, ischium; D, obturator foramen; E, tuberosity of the ischium; F, cotyloid cavity.

advances in age, the former diminishes and the latter increases in density and thickness. It is a flat bone, widely expanded at either extremity, rather constricted in the middle portion, and curved or twisted in two different directions, its anterior and upper portion forming an obtuse angle with its lower and posterior division; so that whilst its external surface looks downward in the lower portion, it is directed outwards, and even backwards and upwards, in the upper portion. About its middle this surface presents a wide, deep articular depression, surrounded by a high rim—the cotyloid cavity, or

acetabulum—in which the corresponding articular head of the femur is lodged and moves. Above this cavity is a marked, roughed, thin convex ridge — the supracotyloid crest or superior ischiatic spine, into which the sacro-sciatic ligament is fixed.

Below the cotyloid cavity, and inclining inwards, is a large circular or oval aperture, which is closed by the obturator muscles, and is named the thyroid or obturator foramen.

The two coxæ are united inferiorly in the median line by a solid suture—the ischio-pubic symphysis—and form by this junction a kind of V-shaped figure, the widest portion of which is in front, and renders the transverse diameter of the pelvis more extensive before than behind. Above they articulate with the sacrum.

The *Ilium* is the largest portion of the coxa, of which it forms the uppermost segment. It is flat and triangular in its upper half, thick and prismatic below (the shaft of ilium). The direction of its long axis is obliquely downwards, inwards, and backwards.

The gluteal surface faces backwards, outwards, and upwards. It is concave and broadest above, and covered by the gluteal muscles. The iliac surface is directed forwards, is narrow below, and above it is fused with the sacral or pelvic surface. It is covered by the iliacus muscle. The inner surface, called the pelvic or sacral, forms the lateral boundary of the pelvis. It is smooth and concave in its length. It can easily be felt *per rectum* or *vaginam*. It is crossed vertically by the obturator nerve, which may be injured during difficult parturition. At its upper third this surface is marked by a transversely elongated rough facet, the auricular facet, for articulation with the sacrum. The joint which is formed is an obscure diarthrodial joint, and the capsular ligament bounding it is exceedingly strong, and prevents any appreciable movement between the two bones.

The pubic edge or ilio-pectineal line separates the iliac from the sacral surface, and forms the side of the entrance to the pelvis. It is marked in its inferior third by a rough projection, psoas tubercle, to which the psoas parvus is attached. The ischiatic edge separates the gluteal from the sacral surface It is concave in its length, and forms chiefly

the anterior boundary of the great sacro-sciatic foramen, through which the sciatic nerve and gluteal vessels and nerves leave the pelvis. At its lower extremity it takes part in forming a sharp curved prominence, the supracotyloid crest, or superior ischiatic spine.

The upper extremity of the ilium forms a pronounced curved edge, the crest, at the outer angle of which is formed a strong ridge, limited by two pairs of tuberosities, the external angle of the ilium or angle of the haunch (tuber coxæ). The inner angle is an acute process, the angle of the croup, which forms the highest point of the skeleton in that region.

The lower extremity of the ilium joins the ischium and pubis in the cotyloid cavity.

The *Ischium* is next in size to the ilium, and forms the posterior part of the floor of the pelvis. It is flat and irregularly quadrilateral. The upper surface is smooth and nearly flat. The anterior border is thick and concave, and forms the posterior boundary of the obturator foramen.

The posterior border is straight, and directed obliquely forwards and inwards, forming, with its fellow of the opposite side, a wide notch, the ischial arch. The external border is smooth and concave, and forms the lower lip of the inferior or lesser sacro-sciatic foramen. The internal border joins its homologue of the opposite side to complete the ischio-pubic symphysis.

The antero-external or cotyloid angle is the most voluminous, and joins the pubis and ilium in the cotyloid cavity.

The antero-internal angle joins the posterior angle of the pubis.

The postero-external angle, commonly named the point of hip, forms a thick process, tuber ischii, which is continued forwards by a prominent ridge, elongated from before to behind, the thin margin of which is curved outwards and downwards (the inferior ischiatic spine).

The postero-internal angle constitutes with that of the other ischium the summit of the ischial arch.

The *Pubis* is the smallest segment of the coxa, and forms the anterior portion of the floor of the pelvis. It is irregularly triangular in shape.

The upper surface is concave and smooth in the adult mare,

convex in the young animal. The lower face is rough, and traversed in its length by a wide groove which reaches the bottom of the acetabulum, and lodges the pubio-femoral ligament (accessory ligament of the hip-joint) and a very large vein

The anterior border is thin and uneven, and is curved like the arc of a circle ; it concurs in forming the anterior circumference of the pelvis. The posterior border is thick and concave, and forms the anterior boundary of the oval obturator foramen. The inner border joins that of the opposite pubic bone in the middle line, to form the anterior portion of the ischio-pubic symphysis. The external or cotyloid angle is thick, and constitutes the largest portion of the roughened depressed surface at the bottom of the acetabulum. The internal angle is united to the corresponding angle of the opposite bone. The posterior angle is fused at an early age with the antero-internal angle of the ischium, to form the inner boundary of the obturator foramen.

During life the spongy tissue of the bone is gradually replaced by compact bone, and in old age has entirely disappeared. The compact bone is most abundant near the acetabulum, so that here the shape of the pubis cannot be altered at the time of parturition because of the resulting rigidity. Here also ossification begins.

The *Sacrum* is formed by the fusion of five sacral vertebræ. It is triangular in shape, with the base directed forwards. It articulates in front with the last lumbar vertebra, behind with the first coccygeal bone, and laterally with the ossa innominata.

The upper face carries the five supraspinous processes of the sacral vertebræ. On each side of the spines are placed four openings, the superior sacral foramina communicating below with others on the inferior surface, also with the spinal canal. The lower face is smooth and slightly concave from before to behind. It forms the larger portion of the roof of the pelvic cavity. It is crossed transversely by four lines, indicating the points of junction of the vertebræ; and at the lateral extremity of each line is situated a foramen, the inferior sacral, from which emerges the inferior branch of sacral nerves. These nerves, especially the first two, may be occasionally injured during the passage of the fœtus at a

difficult parturition. Probably the second last lumbar nerve is more likely to be injured as it passes over the promontory formed by the lumbo-sacral articulation. From this nerve is detached a large portion of the obturator and anterior gluteal nerves.

Each lateral border is concave in its length. In front is an irregular, elongated surface, the auricular facet, obliquely directed, for articulation with the innominate bone, and the edges of this surface give attachment to the strong fibres of the (ventral) sacro-iliac ligament. Behind this, the lateral border is sharp, and affords attachment to the inferior ilio-sacral (lateral sacro-iliac) and sacro-sciatic ligaments.

The base or anterior extremity is articulated to the last lumbar vertebra, with which it forms a salient angle—the sacro-vertebral angle or promontory—which looks down towards the abdominal cavity. The joints contracted here are five in number: (1) The intercentral joint, formed between the centra of the first sacral and the last lumbar vertebræ; (2) and (3) two small oblique joints, diarthrodial in character, formed between the anterior articular processes of the first sacral vertebra and the posterior oblique processes of the last lumbar; (4) and (5) at each side of the intercentral joints a large diarthrodial joint, similar in extent to the latter, between the base of the sacrum and the transverse processes of the last lumbar vertebra. Above the centrum, at the front of the sacrum, is situated the triangular opening into the portion of the spinal canal within that bone. This canal, as it extends backwards, becomes gradually smaller to the posterior extremity. The latter presents below the canal a small oval surface for articulation with the centrum of the first coccygeal bone.

The sacrum is more or less inclined downwards from before to behind, according to the breed of the mare.

The Coccyx.—The coccygeal or tail bones are a series of small cylindrical or irregularly prismatic pieces, from eighteen to twenty in number, behind the sacrum. The first three, which form the base of the tail, lie at the posterior part of the roof of the pelvis, and carry the rudimentary processes of typical vertebræ.

In the pelvis of the *cow* the space between the two coxæ is scarcely so great in front as behind; the ilium not so large,

the external angle (tuber coxæ) carrying only three tuberosities. The ilium is more vertical than in the mare, and is wider at its lower extremity because of the height of the superior ischiatic spine. The gluteal surface is crossed obliquely downwards to the superior ischiatic spine by a distinct ridge. The ischium is thinner than in the mare, but is broader, and is more curved from before to behind and from side to side. The tuber ischii is trifid. The pubis is wide and thin; the slight groove on its inferior surface does not pass into

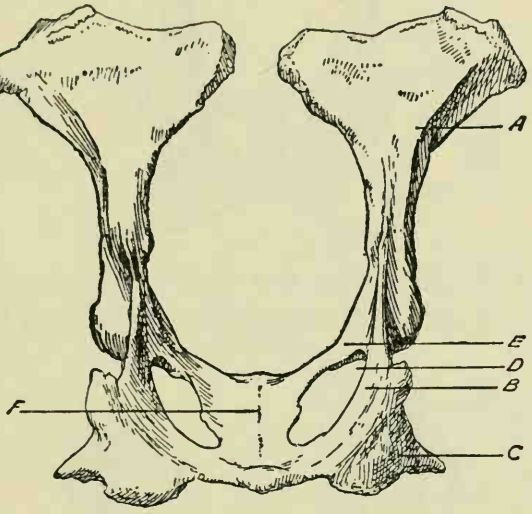

FIG. 2.—PELVIS OF THE COW FROM BEHIND.
A, Ilium; B, ischium; C, tuber ischii; D, obturator foramen; E, pubis; F, ischio-pubic symphysis.

the cotyloid cavity. The obturator foramen is large, and the margin thin.

The ischio-pubic symphysis has on the middle of its inferior face a thick protuberance, flattened on each side and pointed. In early life this is an epiphysis, which, bifurcating posteriorly, is continued along the posterior border of the ischial bones as far as the ischial tuberosity in the form of two marginal bands.

The sacrum is larger, longer, and more curved, than that of the mare. The lateral borders are sharp and directed downwards. The auricular facets are more vertical than in the mare. The spines are also fused. There are no facets for articulation with the transverse processes of the last lumbar vertebra. The coccygeal bones are stronger and more

tuberous. The pelvis of the cow has therefore more extensive bony walls than that of the mare; it is also lighter and less voluminous.

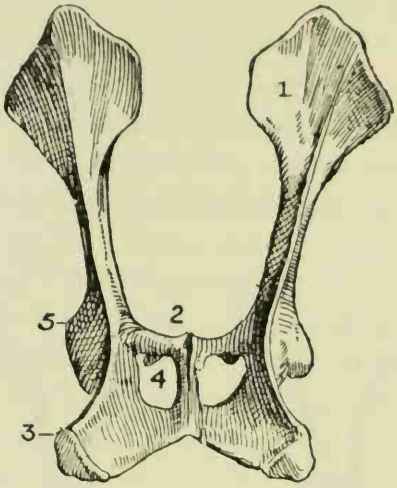

FIG. 3.—PELVIS OF THE SHEEP FROM BEHIND.
1, Ilium; 2, pubis; 3, tuber ischii; 4, obturator foramen; 5, acetabulum.

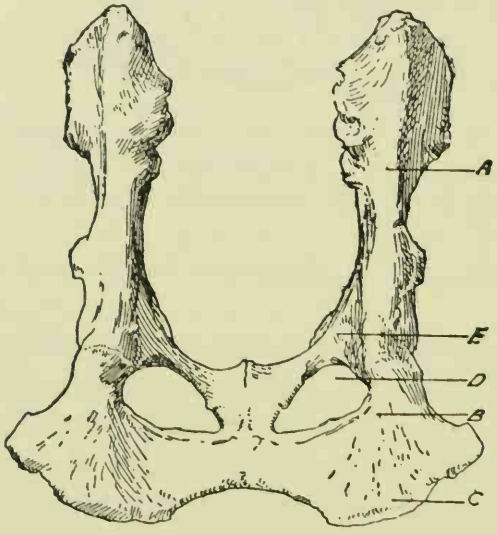

FIG. 4.—PELVIS OF A BITCH (AGED) FROM BEHIND.
A, Ilium; B, ischium; C, tuber ischii; D, obturator foramen; E, pubis.

The bones of the pelvis of the *sheep* and *goat* greatly resembles those of the ox.

The ilium is longer, the superior ischiatic spine is less

developed. The ischium is nearly rectilinear. The pelvis is more horizontal and comparatively longer than in the cow.

The sacrum consists of four bones only.

In the *bitch* and *cat* the transverse diameter of the pelvis is greater behind than before. The ilium is almost vertical, and its gluteal surface is depressed; the crest is convex, and the external angle of the ilium is rounded, and not prominent. The ischial arch is very wide; the tuber ischii has the form of a roughened lip, which is directed outwards, and ends in

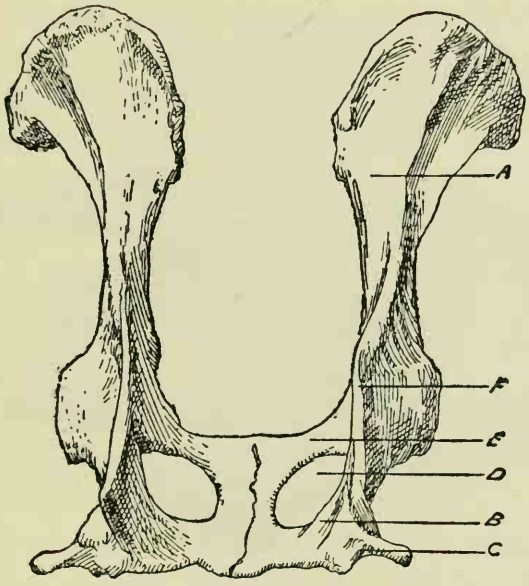

FIG. 5.—PELVIS OF THE SOW FROM BEHIND.

A, Ilium; B, ischium; C, tuber ischii; D, obturator foramen; E, pubis; F, superior ischiatic spine.

a tubercle corresponding with the inferior ischiatic spine of the mare.

The sacrum is somewhat quadrangular. It is composed of three bones, which are consolidated at an early age. The auricular facets are nearly vertical. There are two pairs of superior and inferior sacral foramina. The three spines are very short. The coccygeal bones are strong and tuberous, and the first five or six have the form of typical vertebræ.

The pelvis of the *pig* resembles that of the sheep.

The crest of the ilium is convex; the gluteal surface is divided by a prominent oblique ridge. The superior ischiatic

spine is very large and prominent. The pubis is narrow, and the tuber ischii has the form of strong prominence.

The sacrum consists of four vertebræ, which do not fuse for a long time. The spinous processes are nearly absent, and interannular spaces between the respective vertebræ are very wide.

ARTICULATIONS OF THE PELVIS.

The **Articulations of the Pelvis** are five in number: (1) The sacro-lumbar; (2, 3) the two sacro-iliac; (4) ischio-pubic symphysis; (5) the sacro-coccygeal articulations.

1. The *Sacro-Lumbar Articulation* is formed between the base of the sacrum and the last lumbar vertebra. The union is com-

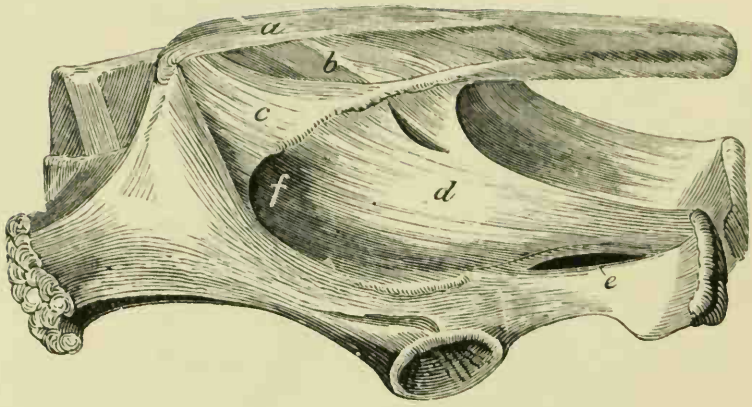

FIG. 6.—LATERAL LIGAMENTS OF THE SACRUM AND PELVIS. (LEYH.)

a, Superior ilio-sacral (dorsal sacro-iliac) ligament; *b*, sacral ligament; *c*, inferior ilio-sacral (lateral sacro-iliac) ligament; *d*, sacro-sciatic ligament; *e*, small sacro-sciatic foramen; *f*, great sacro-sciatic foramen.

pounded of five joints, the intercentral, intertransverse, and oblique. Of these, the last two are diarthrodial and provided with strong capsular ligaments, and the first is amphi-arthrodial, and the bones are united by the intervertebral disc of fibro-cartilage. The articulations are further strengthened by the ligamentum flavum uniting the arches of the two bones, and the superior and inferior common ligaments above and below the centra respectively. The movement which is allowed is very restricted because of the strong union, and yet the joints are never ankylosed in old age nor yet by accident, even if all the lumbar vertebræ should happen to be

consolidated. The arrangement confers great strength and solidity upon the region. In the cow the intertransverse joints are absent, and in that animal there is a liability to incomplete luxation, which may at times become an obstacle to parturition. The sacro-vertebral angle is here formed, but because of its small development and distance from the pelvis it offers little or no obstacle to parturition in the lower animals.

2, 3. *Sacro-Iliac Articulations.*—The sacro-iliac articulation of each side establishes the union of the posterior limb with

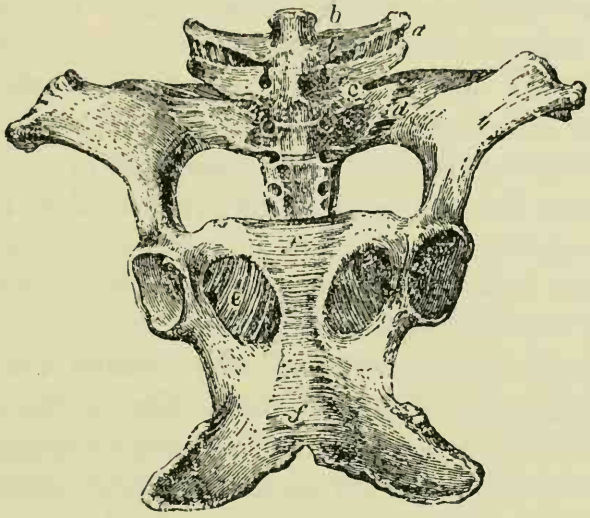

FIG. 7.—LIGAMENTS OF THE LUMBAR VERTEBRÆ, SACRUM, AND PELVIS, SEEN FROM BELOW. (LEYH.)

a, Intertransverse ligament of the lumbar vertebræ ; *b*, capsular ligament of the transverse process of the fifth and sixth lumbar vertebræ; *c*, capsular ligament of the sacrum ; *d*, (ventral) sacro-iliac ligament ; *e*, obturator ligament; *f*, transverse ligament of the ischio-pubic symphysis.

the spine, and is formed by the sacrum and the iliac bones. It is a gliding joint (an arthrodia). At the auricular facets the sacrum is fixed between the antero-superior extremities of the two iliac bones, like a horizontal wedge or the keystone of an arch inverted—the transverse diameter is greater above than below—the pressure it has to resist being from below. Each of the oblong roughened surfaces on the sacrum and ilium is provided with a layer of cartilage to diminish shock and facilitate movement, which is further promoted by each articulation being provided with a synovial membrane, though the amount of synovia secreted is very trifling. The union of

the bones at this part is strengthened by four powerful ligaments—(ventral) sacro-iliac, two ilio-sacral (dorsal and lateral sacro-iliac), and the sacro-sciatic. The movements of this articulation are very limited, but still useful in locomotion and parturition, yet the joint rarely, if ever, becomes consolidated.

4. The *Ischio-Pubic Symphysis* is formed by the junction of the two ossa pubis and ischia. The bones are joined by a layer of fibro-cartilage between the margins of these two bones, which become ossified more or less completely and rapidly according to species, and by a layer of white ligamentous fibres—short and compact—which pass across above and below, the latter being the stronger. The movements of this articulation are very limited, and depend solely upon the elasticity of the interosseous cartilage; they are abolished when ossification occurs. This happens in the majority of horses before middle age, though sometimes the posterior portion is cartilaginous after this period. The ossification extends from before backwards. Complete fusion of the two ischia does not occur till late in life.

5. *Sacro-Coccygeal Articulations* resemble the intercentral joints of other vertebræ. A thick disc of fibro-cartilage is interposed between the centra of adjacent coccygeal vertebræ, the first of which is joined to the posterior extremity of the sacrum. Their solidity is further assured by a common fibrous sheath which completely envelops them, but without interfering with their mobility. This mobility greatly favours parturition, but not infrequently the first coccygeal bone is completely ossified with the sacrum; and as this necessarily limits the elevation of the tail, it diminishes the vertical diameter of the posterior opening of the pelvis, and may in this way prove an obstacle to the expulsion of the fœtus.

In all the domesticated animals other than the equine species there are no articulations between the transverse processes of the last lumbar vertebræ and the base of the sacrum. These latter are connected only by an interosseous ligament.

In the *cow* more particularly, therefore, there is greater mobility in the sacro-lumbar articulation, which would render a change in direction of the pelvis easier during parturition for the passage of the fœtus.

The ischio-pubic symphysis is very long, is not straight,

but much depressed about its middle. Ossification takes place much later than in the mare, and extends forwards from the ischial arch. A prominent crest is often formed along its pelvic aspect, which may greatly fatigue the hand of the obstetrist by pressure in manipulating the fœtus within the pelvis.

In the *sheep*, *goat*, and *pig*, the ischio-pubic symphysis is rectilinear, and ossification commences late in life, and is often absent in animals which have had many young.

The **Sacro-Sciatic Ligament** completes the lateral wall of the pelvic cavity behind between the sacrum and innominate bone. It is a wide four-sided fibrous membrane in which the white fibres are interwoven. Its upper border is straight, and fixed to the lateral border of the sacrum and the first few coccygeal bones. Its lower border is attached to the superior ischiatic spine and tuber ischii. Between these two points it forms, with the ischium, a slit-like opening, the lesser sacro-sciatic foramen, through which the obturator internus muscle passes. The anterior border between the superior ischiatic spine and the sacrum bounds, with the ischiatic edge of the ilium, the greater sacro-sciatic foramen, through which the gluteal vessels and nerves and the sciatic nerve leave the pelvis for the thigh. Compression of these nerves against the bones of the pelvis during parturition may account for cramp of the hind limbs, or even post-partum paralysis. The posterior border is not well defined, and is continuous with the semimembranosus muscle, and above with the fascia over the muscles of the tail. The inner surface is covered with peritoneum in its anterior third. In its posterior two-thirds it is connected with the pelvic organs by means of loose fibrous tissue. Its outer face is crossed by the sciatic and gluteal nerves, and the middle gluteus, biceps femoris, and semitendinosus muscles. In the bitch the ligament has the form of a strong band, passing from the lateral border of the sacrum to the tuber ischii.

There are no marked differences in this ligament in other animals.

THE PELVIS AND ITS CAVITY.

It is important, from an obstetrical point of view, and for the full comprehension of the mechanism of parturition, to consider the conformation, dimensions, axes, and the other features of the pelvis as a whole.

The cavity of the pelvis is the space between the inlet and the outlet. With these openings it is capable of more or less increase in capacity in every direction, through relaxation of the pubic and sacro-iliac articulations and the sacro-sciatic ligaments. The yielding of the latter is very noticeable in the larger animals immediately before parturition, as well as

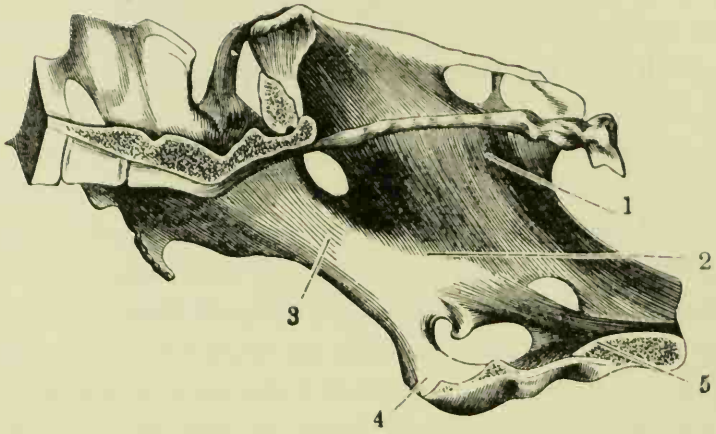

FIG. 8.—LONGITUDINAL SECTION OF A MARE'S PELVIS. (SAINT-CYR.)
1, Sacro-sciatic ligament; 2, superior ischiatic spine; 3, ilium; 4, pubis; 5, ischium.

the elevation of the coccyx by the body of the fœtus in its passage outwards. The pelvis also permanently widens in animals which have had young frequently; this accounts for the peculiar rocking gait they exhibit in progression, and this is also aided by the persistent relaxation in the above-mentioned ligaments. The anterior margin of the floor of the cavity is nearly straight, and its posterior border is deeply cut into by the ischial arch, while the floor itself often offers some diversities. It may be convex in front and concave behind, or *vice versa*, the concavity being separated from the convexity by a transverse ridge, which may also be represented by a series of small conical eminences; or the floor may be a

smooth plane sloping upwards from before to behind, with a kind of raised border surrounding the anterior contour of the obturator foramen.

The pelvis of the *mare* is a slightly cone-shaped cavity continuous in front with the abdomen. The base of this conical space, intersected obliquely downwards and backwards, is anterior; its axis forms, with that of the abdomen, a very wide angle, the sinus of which is inferior. The summit of the cavity is posterior.

In transverse section the canal is oval in shape, the widest transverse diameter of which lies near the pubis, the narrowest towards the sacrum.

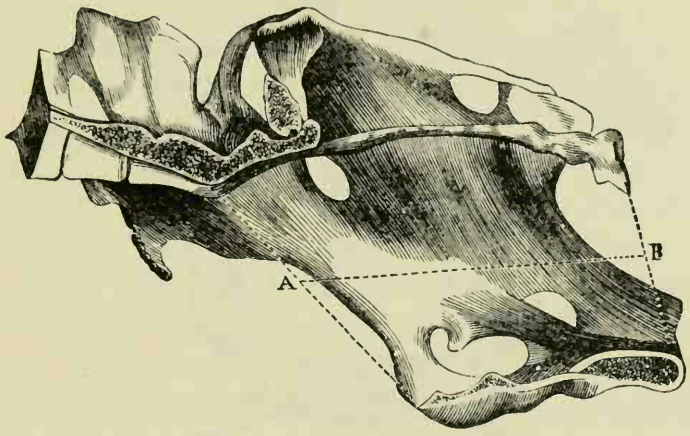

FIG. 9.—DIAGRAM OF THE MARE'S PELVIC AXIS. (SAINT-CYR.)
A, Inlet; B, outlet.

The internal surface is more regular than the external.

The roof (superior, sacral, or rectal plane) is formed by the lower surface of the sacrum and the first two or three coccygeal vertebræ. It is slightly concave longitudinally. It is in contact with the rectum, the subsacral vessels, and sympathetic nerves.

The inferior plane or floor is formed by the upper surface of the pubic and ischial bones. It is rectilinear in form from before to behind, and concave from side to side. The ischio-pubic symphysis, occupying the median line, is prominent, and varies in length according to the size of the animal, being usually about 6 or 7 inches. In front, at the pubis, is a depression more or less marked, in which the previously

emptied bladder can be lodged during the passage of the fœtus. On each side is the obturator foramen, which is covered by the obturator internus muscle, and through which the obturator vessels and nerve leave the pelvis.

The lateral planes are formed by the ilia and the superior ischiatic spines, and by the sacro-sciatic ligaments. The obturator vessels and nerves are directed downwards on the ilium. The great sacro-sciatic foramen behind the ilium permits the passage of the great sciatic nerve, the gluteal vessels and nerves, and the sacro-sciatic ligament is crossed by the internal pudic vessels and the pudic nerve.

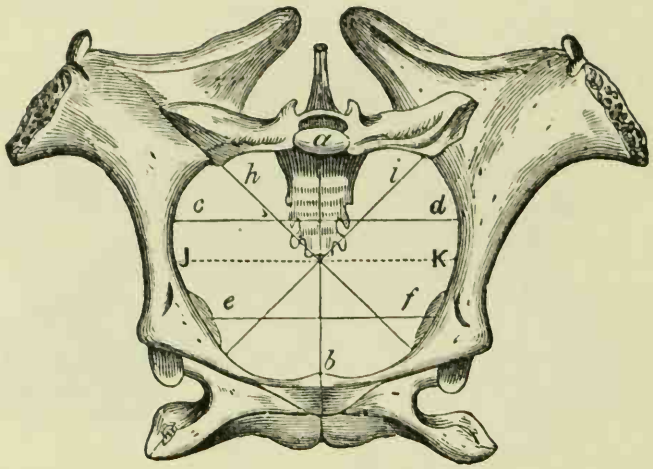

FIG. 10.—INLET OF THE PELVIS OF THE MARE: WIDE PELVIS. (SAINT-CYR.)

ab, Supero-inferior or sacro-pubic diameter; *cd*, superior bis-iliac diameter; *ef*, inferior bis-iliac diameter; *ei*, *fh*, oblique, ilio-sacral, or sacro-iliac diameters; JK, middle diameter.

The compression of the above nerves by the uterus and its contents causes the cramps pregnant animals experience towards the termination of gestation. The lateral planes are readily dilatable during parturation, chiefly behind the ilium.

The Anterior Opening or Inlet, also called the brim, anterior circumference, or abdominal opening, of the pelvis, is nearly circular or oval in outline, the widest part lying near the sacrum. It is obliquely inclined downwards and backwards, and is bounded above by the anterior border of the sacrum and its articulations with the lumbar vertebræ and

ilia, below by the anterior border of the pubic bones, and at each side by the ilio-pectineal line. On account of its rigid bony walls and the strong articulations between the bones, the inlet cannot be dilated to any appreciable degree under the most violent efforts, even supposing the sacro-iliac and ischio-pubic ligaments become relaxed before pregnancy—a change which must be indeed rare in the mare.

The *diameters of the inlet* have been carefully investigated by Franck, Saint-Cyr, and Violet, and are of some interest to the obstetrist. At the same time they vary according to the size of the animal, but their relative dimensions are of much practical importance.

The dimensions are taken between the following points :

1. *A supero-inferior or sacro-pubic diameter*, rather oblique, is the distance between the sacro-vertebral angle and the symphysis pubis. It is generally the largest diameter, and should therefore receive the widest part of the fœtus when it enters the pelvis. The average diameter is between 8 and 10 inches. Occasionally it is less than the transverse diameter.

2. *A superior transverse or bis-iliac diameter* is taken about the upper third of the pelvic cavity—*i.e.*, at the point where the anterior opening presents its greatest width, and corresponds to the shoulder and hip joints of the fœtus when it is in the dorso- and lumbo-sacral positions.

3. *The inferior transverse or bis-iliac diameter* is taken at the lower fourth of the cavity between the two psoas tubercles. It corresponds to the elbow and stifle joints of the fœtus.

4. *The oblique, ilio-sacral, or sacro-iliac diameters* pass from the sacro-iliac joint, through the middle of the inlet, to the psoas tubercle of the opposite side, just about the centre of the cotyloid cavity. They are usually intermediate in length between the superior bisiliac and the sacro-pubic diameters. Their importance is secondary in consequence of the position of the fœtus during parturition, a position characterized by the vertical direction of its median longitudinal plane; but when the sacro-pubic diameter is less than the superior transverse, the fœtus may penetrate the pelvic passage inclined on one side, its median plane coinciding then with one of the oblique diameters. In the she-ass the

inlet is generally oval, and the sacro-pubic diameter slightly exceeds the transverse in measurement.

The **Posterior Opening or Outlet**, sometimes also called the perinæal circumference or recto-urethral opening, is limited above by the apex of the sacrum and base of the coccyx, below by the ischial arch, and laterally by the posterior border of the sacro-sciatic ligaments. The opening is oval. The diameters are much less than those of inlet — about one-fifth less. This circumstance has rarely any influence in parturition, as the opening is very dilatable, owing to the relaxation that takes place in

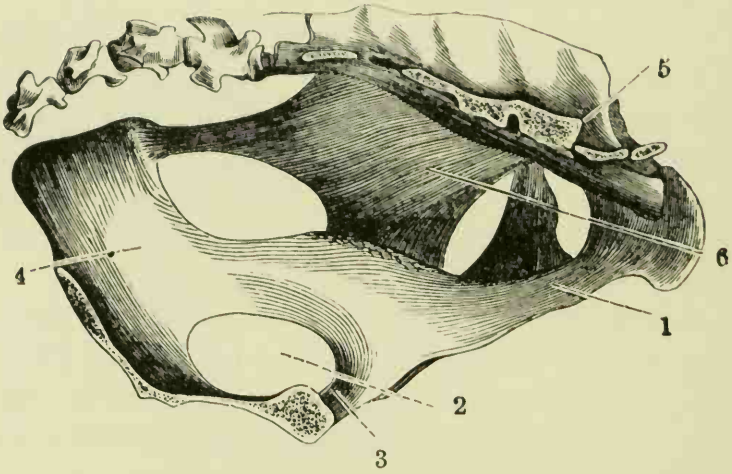

FIG. 11.—LONGITUDINAL SECTION OF THE COW'S PELVIS. (SAINT-CYR.)
1, Ilium; 2, obturator foramen; 3, pubis; 4, ischium; 5, sacrum; 6, sacro-sciatic ligament.

the sacro-sciatic ligaments during the later months of pregnancy, and the great mobility of the sacrum and coccyx.

In the *cow* the pelvis is longer than in the mare, and less nearly vertical. The ischio-pubic symphysis is also longer, and is very much curved, so that the floor of the pelvis is basin-like. The bladder is more completely sheltered here during parturition. The ischial arch is more deeply cut at the symphysis, and more acute. The external border of the ischium is higher, and the superior ischiatic spine is thinner and more elevated. The bony walls of the cow's pelvis are hence more extensive.

The inferior surface of the sacrum is larger, longer, and more concave, and the sacro-sciatic ligaments longer, though narrower.

The pelvic cavity is compressed from side to side. The inlet is more oblique than in the mare, and the sides are nearly parallel for some distance about the middle of its height. The two transverse diameters differ, therefore, little in width. The sacro-pubic diameter is much greater than the transverse, by about one-third according to Saint-Cyr, or by 3 to 10·4 centimetres. As Goubaux has noted, the abdominal muscles are inserted under the anterior border of the pubis, so that the latter forms a prominence (the floor of the pelvis being on a higher level than the abdominal floor), which creates a kind of steep step which the calf must ascend before

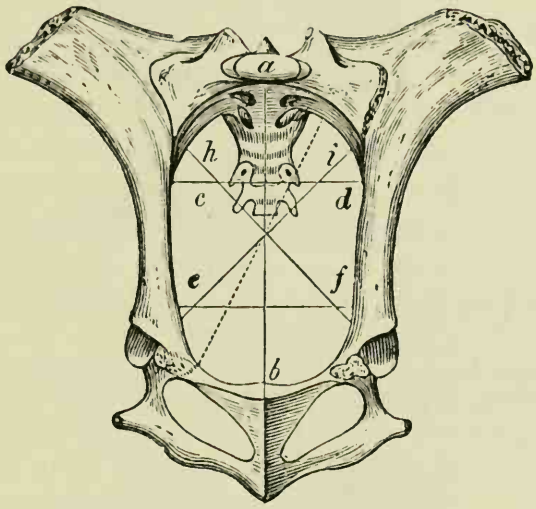

FIG. 12.—INLET OF THE COW'S PELVIS: NARROW PELVIS. (SAINT-CYR.)
ab, Supero-inferior or sacro-pubic diameter; *cd*, superior bis-iliac diameter; *ef*, inferior bis-iliac diameter; *ei*, *fh*, oblique, ilio sacral or sacro-iliac diameters.

it can enter the pelvic cavity. This often proves a barrier to the passage of the fœtus.

The dimensions of the outlet are not so reduced as in the mare, and are about those of the transverse diameter of the inlet. Hence the pelvis is more cylindrical.

This feature does not tend to render parturition more easy, because the pelvic cavity is longer, the osseous walls are more extensive, and the symphysis is very much curved.

In the *sheep* and *goat* the pelvis does not differ much from the cow's save in size. The symphysis is nearly rectilinear, and ossification occurs but very slowly.

In the *sow* the pelvis is spacious and elongated; its symphysis is rectilinear. The sacro-vertebral angle is pro-

minent, and the plane of its anterior circumference is more oblique.

In the *bitch* and *cat* the sacro-vertebral angle is still more

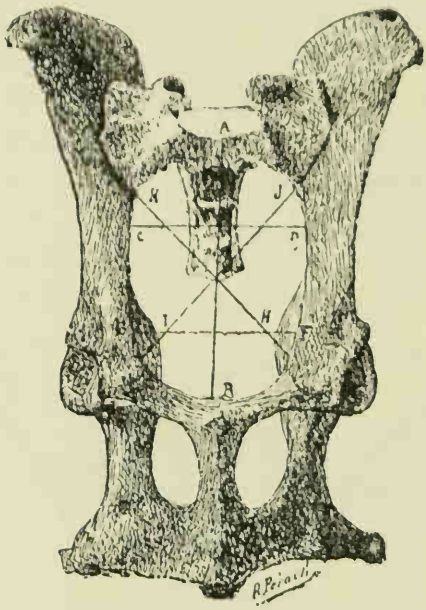

FIG. 13.—INLET OF PELVIS OF SOW. (FROM BOURNAY'S "OBSTÉTRIQUE VÉTÉRINAIRE.")

AB, Sacro-pubic diameter; RH, IJ, ilio-sacral diameters; CD, superior bis-iliac diameter; EF, inferior bis-iliac diameter.

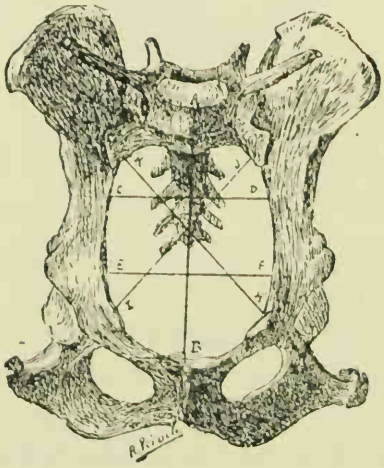

FIG. 14.—INLET OF PELVIS OF BITCH. (FROM BOURNAY'S "OBSTÉTRIQUE VÉTÉRINAIRE.")

AB, Sacro-pubic diameter; CD, superior bis-iliac diameter; EF, Inferior bis-iliac diameter; KH, IJ, ilio-sacral diameters.

prominent. The symphysis is rectilinear; the pelvic cavity is nearly cylindrical and much elongated. Its more contracted

point lies at the level of the superior ischiatic spine. Here the fœtus becomes arrested when it is very large. The anterior opening is oblique; its inferior interiliac diameter surpasses the superior.

Differences in the Pelvis according to Sex.

There is a considerable difference in the size and conformation of the male and female pelvis in the domesticated animals, as might be expected from the difference in the sexual functions. The female pelvis is larger in every sense, but more particularly in its transverse diameter.

In the *mare* the inlet is much larger than in the horse. The ilio-pectineal crests are farther apart, the distance between the pubis and sacrum is much greater, while the upper surface of the pubis is concave. In the horse the pubis is thicker, and its upper surface convex. In the mare the inlet is more oblique, the ischiatic spines and ischial tuberosities are more widely separated, and the ischia meet at a more open angle. The ischial arch is wider than in the horse, and forms a more regular curve in joining the tuber ischii. The obturator foramina are larger and more circular in the mare, and the ischio-pubic symphysis is farther from the cotyloid cavities. The sacrum is also broader and longer in the mare, and rather more concave from before to behind.

The differences in the pelvis of the mare and the horse are sometimes noticeable at birth; but they are generally most apparent when the adult period has been reached, and the body has acquired its definite form. In both sexes the supero-inferior diameter of the pubis is greater than the transverse in early life. Some idea of the difference in dimensions of the pelvic cavity may be obtained from the following measurements of two animals of about the same size:

	Vertical Diameters.		Horizontal Diameters.	
	Between the Sacrum and Pubis.	Between the Sacrum and Ischium.	Between the Ilio-Pectineal Crests.	Between the Ischiatic Spines.
	Inches.	Inches.	Inches.	Inches.
Mare ...	9	$6\frac{9}{10}$	$9\frac{1}{4}$	$7\frac{1}{2}$
Horse ...	8	$6\frac{3}{10}$	8	$6\frac{1}{2}$

The pelvis of the gelding which has been castrated in early life takes on many of the characters of that of the mare.

These sexual differences are also noted to some extent in the other domesticated animals, but are not so marked in the smaller animals until the female has brought forth young several times.

CAPACITY OF THE PELVIS, OR PELVIMETRY.

The diameters or dimensions of the pelvis vary in each species according to the different sizes of the animals, in the mare, cow, pig, and bitch, even to the extent of nearly 2 or 3 inches. In the sheep, goat, ass, and cat, very little variation in size occurs, and therefore the dimensions of the pelvis do not vary by more than $\frac{1}{2}$ inch. Pelvimetry is a very important matter to the human obstetrist, because the human pelvis is liable to be deformed or defective in its proportions, and some idea may be obtained beforehand as to whether any danger will arise to mother or child during accouchement. It may also be of some service to know the diameters of the pelvis of different animals, on account of the indications they may furnish in many cases of dystokia. During parturition in herbivora the fœtus is so placed generally, that the withers and shoulders are towards the roof or superior plane of the pelvis, while the sternum and anterior limbs, which form a larger mass, rest on the floor or inferior plane. The passage of the thorax of the fœtus in these animals is, apart from other causes, the chief difficulty in parturition. In the carnivora, frequently the head of the fœtus experiences some difficulty in passing through the pelvis.

The term *diameter*, in obstetrics, is employed to designate the distance between certain parts in the pelvic cavity, by which, practically, we may compare the capacity of that space with the volume of the largest part of the fœtus that has to pass through it.

The most important diameter is certainly that between the middle of the sacrum and the ischio-pubic symphysis in the large animals, and the sacro-coccygeal articulation and ischio-pubic symphysis in the smaller animals. The pelvis of the domesticated animals forms a very inclined plane ; and if we

draw a vertical line from the pubic symphysis towards the spine, it will pass through the middle of the sacrum in the large animals, and the sacro-coccygeal articulation in the smaller animals. This point is the narrowest through which the fœtus has to pass, and in which it will meet with most resistance; for while the top of its shoulder is towards the sacrum, its chest is resting on the pubis. Therefore it may be said that this really forms the first solid resistance to be overcome in parturition.

Considering the variations in size in some species, it is not possible to give general measurements for all, but we will,

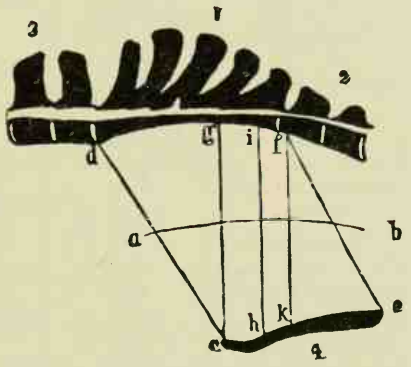

FIG. 15.—MEDIAN SECTION OF THE PELVIS OF THE MARE. (FRANCK.)

1, Sacrum; 2, two first coccygeal vertebræ; 3, two last lumbar vertebræ; 4, ischio-pubic symphysis; *ab*, axis of the pelvic cavity; *cd*, supero-inferior diameter of the inlet; *ef*, supero-inferior diameter of the outlet; *cg*, vertical diameter of the inlet; *ih*, vertical diameter of the mid-pelvis; *kf*, vertical diameter of the outlet.

after Rainard, give average diameters for different-sized animals (see table on pp. 24-25).

Pelvimetry in the living animal may be carried on in two ways:

1. *External Pelvimetry*, which is carried on by calculating the diameters of the pelvis from certain measurements on the outside of the animal. That is done by ascertaining—(1) the distance between the two angles of the haunch; (2) the distance between the two ischial tuberosities; and (3) the height from the hip-joint to the level of the highest point of the croup. For the first measurement, a straight piece of wood is placed vertically against each haunch, and the space between them is measured. The distance between the ischial

Average Diameters of the Pelvis for Different-Sized Animals.

Species.	Height.	Inlet.		Outlet.	
		Diameters.	Measures—	Diameters.	Measures—
			Inches.		Inches.
Horse	15 hands	Supero-inferior Vertical Transverse	$9\frac{1}{2}$ $9\frac{1}{4}$ $9\frac{1}{4}$ to $9\frac{1}{2}$	Vertical Transverse	$6\frac{7}{10}$ $7\frac{1}{2}$
	14 hands	Supero-inferior Vertical Transverse	$9\frac{1}{4}$ to $9\frac{1}{2}$ $8\frac{7}{10}$ $8\frac{7}{10}$ to 9	Vertical Transverse	6 to $6\frac{1}{3}$ $6\frac{7}{10}$ to 7
	12 hands	Supero-inferior Vertical Transverse	$8\frac{3}{10}$ to $8\frac{7}{10}$ $7\frac{9}{10}$ $7\frac{1}{2}$ to $7\frac{3}{10}$	Vertical Transverse	$4\frac{3}{10}$ to $4\frac{7}{10}$ $5\frac{1}{10}$ to $5\frac{1}{2}$
Ass	Medium size	Supero-inferior Vertical Transverse	$7\frac{9}{10}$ $5\frac{9}{10}$ $4\frac{7}{10}$	Vertical Transverse	$4\frac{7}{10}$ $3\frac{9}{10}$
Cow	Medium size	Supero-inferior Vertical Transverse	$8\frac{7}{10}$ $7\frac{9}{10}$ $7\frac{1}{10}$	Vertical Transverse	$7\frac{9}{10}$ $7\frac{1}{2}$
Sheep	Ordinary size	Supero-inferior Vertical Transverse	$4\frac{7}{10}$ $2\frac{4}{10}$ $3\frac{1}{10}$	Vertical Transverse	$3\frac{1}{2}$ $2\frac{3}{5}$
Goat	Medium size	Supero-inferior Vertical Transverse	$4\frac{3}{4}$ $2\frac{3}{4}$ $3\frac{1}{2}$	Vertical Transverse	$2\frac{3}{4}$ $2\frac{3}{4}$
Pig	$27\frac{1}{2}$ in. Length from snout to tail, $54\frac{3}{4}$ inches.	Supero-inferior Vertical Transverse	4 $3\frac{2}{10}$ $3\frac{2}{10}$	Vertical Transverse	$2\frac{4}{10}$ 4
Dog	Large	Supero inferior Vertical Transverse	$2\frac{1}{3}$ 2 2	Vertical Transverse	$2\frac{1}{3}$ 2
	Small	Supero-inferior Vertical Transverse	2 $1\frac{6}{10}$ $1\frac{2}{10}$ to $1\frac{6}{10}$	Vertical Transverse	2 $1\frac{6}{10}$
Cat	Ordinary size	Supero-inferior Vertical Transverse	$2\frac{1}{3}$ 2 $1\frac{2}{10}$	Vertical Transverse	$2\frac{1}{3}$ $1\frac{6}{10}$

MARE.

Diameters.	Baumeister and Rueff.	Carsten-Harms.	Arloing.	Saint-Cyr.
INLET.	Inches.	Inches.	Inches.	Inches.
Supero-inferior diameter	9 to 10	$9\frac{1}{2}$	9	$8\frac{3}{4}$
Transverse diameter ...	11 to $12\frac{1}{2}$	$9\frac{1}{5}$	$9\frac{1}{5}$	$8\frac{1}{10}$
OUTLET.				
Supero-inferior diameter	9 to 10	$7\frac{1}{2}$	7	
Transverse diameter ...	9	$6\frac{1}{2}$	$7\frac{1}{2}$	

Cow.

Diameters.	Baumeister and Rueff.	Carsten-Harms.	Arloing.	Saint-Cyr.
INLET.	Inches.	Inches.	Inches.	Inches.
Supero-inferior diameter	9 to $9\frac{1}{2}$	$8\frac{1}{6}$	—	$10\frac{1}{3}$
Transverse diameter ...	$6\frac{3}{4}$ to $7\frac{3}{4}$	7	—	$7\frac{1}{4}$
OUTLET.				
Supero-inferior diameter	9	—		
Transverse diameter ...	9	$6\frac{1}{2}$		

tuberosities is taken directly with a tape-measure. In the third case a straight piece of wood is placed horizontally across the summit of the croup, while another is laid in the same direction along the trochanter and ischial tuberosity, the vertical distance between the two pieces giving the measurement. The transverse diameter of the outlet of the pelvis is taken as being nearly equal to one-fourth of the distance between the haunches added to that between the ischial tuberosities; while the supero-inferior diameter of the outlet is supposed to be equal to three-fourths of the vertical distance between the coxo-femoral joint and the croup. Arloing calculates that the sacro-pubic diameter of the inlet equals $\frac{13}{10}$ of the vertical diameter of the outlet, and the transverse diameter of the inlet equals $\frac{12 \cdot 2}{10}$ of the transverse diameter of the outlet.

Saint-Cyr attempts also to fix a ratio between the height of the mare and the sacro-pubic diameters of the pelvic inlet, and between the intervals separating the angles of the haunch and the transverse diameter of the pelvis.

The sacro-pubic diameter is obtained by multiplying the height of the mare by the fraction 0·1515.

For the bisiliac diameter two ratios are required—one for fine, well-bred females, in which the bones are more compact and the connective tissues poorly developed, and which have a relatively large pelvis; the other for coarse, lymphatic mares having strong bony formation, by which the pelvis is smaller than one would *a priori* suppose. The bisiliac diameter is therefore obtained by multiplying the breadth of the croup by 0·4654 for thoroughbred mares, and 0·3945 for coarse bred mares.

In the cow, Saint-Cyr gives the coefficients—0·174 for the sacro-pubic diameter, and 0·0388 for the interiliac diameter. Violet's ratios, obtained in the same way, are slightly different from the above.

The following is a table of coefficients for arriving at the diameters of the inlet to the pelvis in the various domesticated animals, with possible margin of error (Saint-Cyr and Violet):

Nature	Mare.	Cow.	Ewe.	Goat.
Coefficient of sacro-pubic diameter	0·143	0·180	0·180	0·160
Possible error	10 to 20 mm.	5 to 15 mm.		
Coefficient of superior interiliac	0·43	0·36	0·51	0·45
Possible error	10 to 15 mm.	5 to 15 mm.		

By the above means an indication is obtained as to the apparent fitness of the animal for breeding purposes, but it gives no information about the presence or absence of internal abnormalities or defects. For this purpose we must have recourse to direct exploration or internal pelvimetry.

2. *Internal or Direct Pelvimetry* is resorted to by manual examination of the interior of the pelvis through the vagina or rectum. The hand may be successfully employed in ascertaining the different diameters by spans—as the thumb from the index to the middle finger, and even widely spread to the little finger, the distance between these being previously known.

The *axis of the pelvis* is the term given to an imaginary line drawn through the pelvic canal from before to behind at an equal distance from the circumference. In animals there is

only one axis, and that is almost rectilinear, the sacro-vertebral angle or promontory being comparatively little developed, and the sacrum passing in a direct line from the vertebral canal. This rectilinear direction of the pelvic axis is greatly to the advantage of animals during parturition, so that the axis of the canal requires but little notice from the veterinary obstetrist, except when the passage is very constricted.

FEMALE GENERATIVE ORGANS.

The **Mammary Glands**, or **Mammæ**, are the glands destined to secrete the fluid—milk—which is to nourish the young animal for some time after birth. In early life they are very rudimentary, but become developed with age, and attain their full dimensions when the female is capable of reproduction, and especially at the full period of gestation, when their function is about to be carried on actively. After parturition their largest development is reached, and at the end of the period of suckling the young they lose their activity and diminish considerably in size.

In the *mare* the mammary glands are two in number, placed close together, one on either side of the middle line, in the inguinal region, about 9 inches in front of the vulva, and under the prepubic tendon. Externally each is hemispherical in shape, and separated from its fellow by a shallow furrow. From the central portion of each a conical, slightly flattened prolongation—the teat, or nipple—descends. The teat is rounded at the extremity, where two or sometimes three small ducts open. From these ducts the milk is withdrawn by the foal by suction. The glands are attached to the abdominal tunic by means of several wide, short, but elastic, bands. The skin over the udder is thin, smooth, pliable, and provided with numerous sebaceous glands, usually dark in colour, and covered with a soft, short down, save over the extremities of the teats, which are destitute of hair.

Under the skin the gland is covered with a yellow fibrous elastic envelope, which comes in apposition with that of the opposite side, and so forms a complete septum between the two glands. It furnishes from its inner face numerous prolongations, which cross each other in the mass of the gland,

and form septa, or partitions, that divide it into distinct lobes or lobules. Externally this envelope is closely adherent to the skin.

The glandular tissue is of a pinkish-yellow colour and of moderately firm consistence. The lobules into which it is divided are easily identified on section of the gland. The gland is of the racemose tubular type. The lobules consist of clusters of acini, or blind vesicles, which open into ducts leading between the lobules to the base of the teat. Here they open into the galactophorous or lactiferous sinuses.

The *Galactophorous* or *Lactiferous Sinuses* are reservoirs for the reception of milk until it is required by the foal. They are situated slightly above the base of the teat, and are generally two in number—one in front, the other behind. Occasionally there are three or even four sinuses. They nearly always communicate with one another, and are prolonged into the teat by a corresponding number of small terminal and independent ducts which open at the apex of the teat. These ducts narrow towards their openings, which are placed close together. The ducts are lined by a thin mucous membrane, which is continuous at their orifices with the skin.

The teats vary in length with use. They are composed of non-striped circular and longitudinal muscle fibres, which are most developed at the apex, where they act as a sphincter and prevent the passive flow of milk.

The mammary glands are supplied with blood from the subcutaneous abdominal and mammary branches of the external pudic artery. The veins withdrawing the blood partly accompany the arteries, and partly pass through the tendon of origin of the gracilis to join the deep femoral vein. The lymphatic vessels carry the lymph to the supramammary lymphatic glands. The nerve-supply is carried by the inguinal nerves.

The changes which occur in the gland at the age of puberty and the termination of gestation affect not only the size and secretion, but also the minute structure. In the young or virgin mare the gland is hard and scarcely perceptible, and it is not very large in animals which have been pregnant once or twice; but when a mare has borne several foals the mammary gland afterwards remains enlarged and

pendulous. In non-pregnant animals the alveoli, or acini, of the gland are small and filled with epithelium. Towards the end of gestation the gland increases in size and consistence, the alveoli increase in size and number, and the epithelium becomes charged with fat granules.

Towards the end of gestation a clear, albuminous, glairy fluid may be withdrawn from the teats. Shortly before parturition the secretion of milk commences and the acini are enlarged, the epithelial cells in the centre are cast off, and the acini are then lined with a single layer of cubical cells. The maximum size of the acini and of the gland is main-

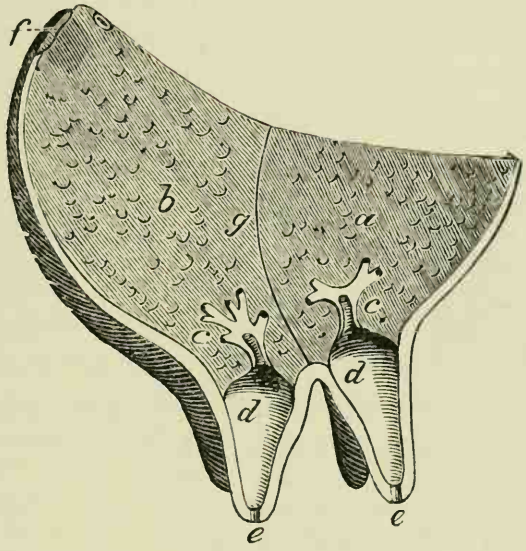

FIG. 16.—SECTION OF UDDER OF COW. (FRANCK.)

a, Anterior quarter; *b*, posterior quarter; *g*, septum between the quarters; *c*, *c*, section of the lactiferous ducts; *d*, *d*, lactiferous sinus or milk cistern; *e*, *e*, orifice of the teat; *f*, large lymph gland in the posterior quarter.

tained with slight variations during the entire period of lactation. At the termination of this period the secretion gradually ceases, and the gland again assumes its quiescent condition and nearly its ordinary size.

In the *cow* the udder is placed in a similar position to the mammary glands of the mare. It consists of four mammary glands called "quarters," distinguished as "hind" and "fore." The right and left glands are easily mapped out; the anterior and posterior quarters are not well separated on the outside. Each quarter has no communication by duct with its neigh-

bour. Each gland has its corresponding teat, much longer and more cylindrical than in the mare. At the base of each teat there is a single galactophorous sinus, and it opens through the teat by a single excretory canal. The lower half-inch of this canal is very narrow and is guarded by a thick wall containing a layer of circular non-striped muscle fibres. Not infrequently behind the four teats one or two rudimentary teats are found; in rare cases they have been observed to be perforate and to yield milk. The teats of the cow are generally from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches long, and the length varies according as the animal has reared a larger or small number of calves.

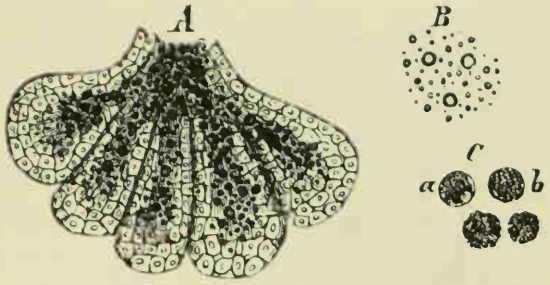

FIG. 17. (VIRCHOW.)

A, Lobule of the mammæ filled with milk; B, milk globules; C, colostrum: *a*, cell with a visible nucleus; *b*, cells from which the nucleus has disappeared.

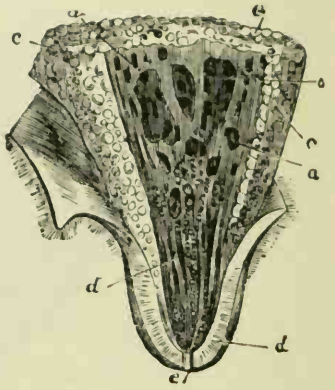

FIG. 18. — SECTION OF THE COW'S TEAT. (GUIBOURT.)

a, *a*, Principal lactiferous ducts; *b*, lactiferous sinus; *c*, *c*, acini; *d*, elastic or dartoid tissue of the teat; *e*, orifice of the teat.

In the cow the secretion of milk can be excited and maintained by regular milking for nine to twelve or fifteen months after the birth of the calf.

Under domestication the activity of the milk glands has been highly developed in the cow and goat to provide the important food-supply to man of milk and its derivatives—cream, butter, and cheese.

In the *sheep* and *goat* there are only two mammary glands, which resemble those of the cow. In the goat two posterior rudimentary teats are sometimes developed, and the galactophorous sinus is very large, and may contain as much as 3 ounces of milk.

In the *pig* the mammæ are ten or twelve in number, disposed in two parallel rows, extending from the inguinal region to beneath the thorax, and distinguished as inguinal, abdominal, and thoracic mammæ. There are no lactiferous sinuses. Two ducts open at the free extremity of each teat. The mammæ are separated by distinct furrows.

In the *bitch* there are eight to ten mammæ, arranged as in the pig. When the mammæ number ten, there are in each row two pectoral, two abdominal, and one inguinal gland. Six to twelve ducts open at the apices of the teats.

The secretion of milk is a special function of the mammary glands, and takes place in the acini. The fluid is conveyed from these into the lactiferous ducts and sinuses, where it is stored until a certain period; this retention after a time distends the glands very much, and puts the elastic envelope greatly on the stretch, while the teat also increases in size, length, and firmness. When this distension becomes inordinate, as in overstocking in cows, it causes the animal uneasiness, pain, and even fever; and if not relieved by natural or artificial means, it may occasion mischief. In the majority of cases the pressure of the envelope on the contained fluid overcomes the resistance of the sphincter at the end of the teat, and relief is afforded in this way.

The Vulva.

The vulva is the posterior portion of the external genital passage. It lies below the anus and above the ischial arch, and is in contact at the sides with the sacro-sciatic ligament and semimembranosus muscle. Its outer opening has the form of a vertical slit, the lateral boundaries of which are called the lips, or labia, which meet above and below at the angles. The upper commissure, or angle, is acute and separated by a very narrow interval, the perinæum, from the anus. The lower commissure is rounded, and presents a small recess accommodating the clitoris. The lips are usually in contact, and vary in length according to the age and condition. They are covered on the outside with a thin, smooth, unctuous, usually pigmented skin, on which the hair is fine and scanty. Internally they are covered with mucous membrane similar to

that covering the vagina. This is constantly lubricated with a greasy mucus with a special odour according to the species; on the free border the skin and mucous membrane meet.

The vulva extends forwards for about 5 inches in the mare, and is continuous with the vagina. The point of separation is the hymen, which is inconstant in the lower animals, and here is only indicated by the position of the meatus urinarius.

The mucous membrane lining the vulva is smooth, pink, and is continuous with that of the vagina. Near the margin of the labia it frequently shows black pigmented patches. It

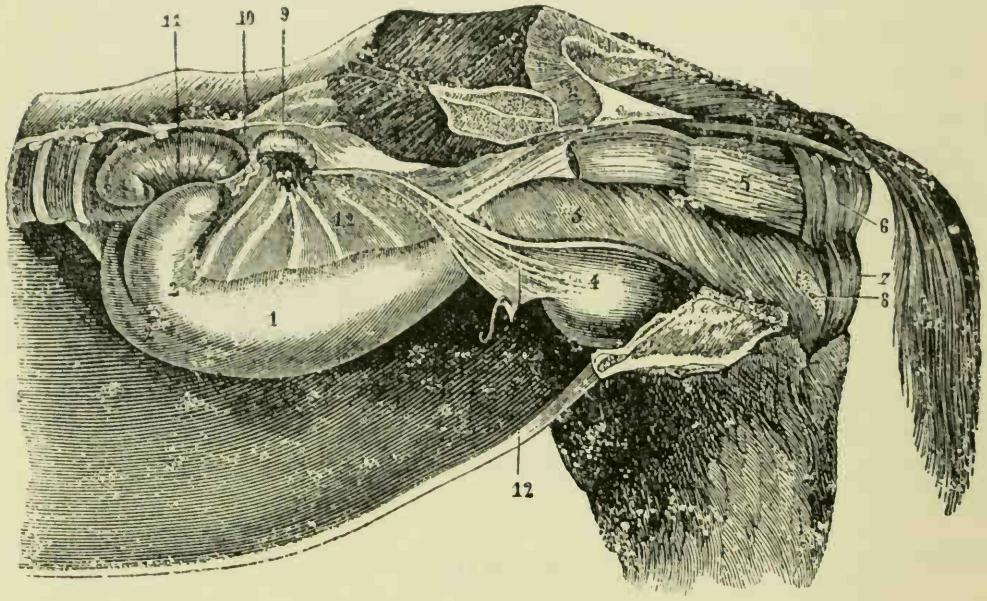

FIG. 19.—THE GENERATIVE ORGANS OF THE MARE *IN SITU*. (SAINT-CYR.)

1, Body of the uterus; 2, 2, cornua of the uterus; 3, vagina; 4, bladder; 5, rectum; 6, sphincter of the anus; 7, constrictor muscle of the vulva; 8, bulb of the vagina; 9, ovary and fimbriated body; 10, Fallopian tube; 11, kidney; 12, 12, broad ligament.

is provided with numerous mucous glands. The wall of the vulva is also provided with two constrictor muscles and an erectile structure, the vaginal bulb. The anterior constrictor of the vulva invests the vulva near the meatus urinarius, where it acts as a sphincter to the vulva and urethra. It is confounded behind with the posterior constrictor. The posterior constrictor of the vulva forms the substance of the labia, and above its fibres are confounded with those of the sphincter ani. Its lower fibres are partly attached to the

clitoris, and throughout its extent it is firmly adherent to the skin. It contracts the vulva during copulation, and compresses the penis; by reason of its attachment to the clitoris, it erects that organ. This especially occurs during œstrum and after urination, when the posterior constrictor of the vulva contracts and the lower commissure of the vulval opening is everted and the clitoris exposed.

The vulva is also provided with muscular ligaments analogous to the retractor penis of the male.

The vaginal bulb is a band of erectile tissue placed between the posterior constrictor and the mucous membrane of the vulva. It passes from the base of the clitoris to the sides of the vulva, where it terminates in a round, salient, or ring-like lobe. During copulation it becomes distended with blood, and so constricts the capacity of the vulva, and assists in rendering the coaptation of the copulatory organs more complete. It is homologous with the corpus spongiosum of the male penis.

The *Clitoris* is an exact but miniature counterpart of the corpora cavernosa of the male penis. From 2 to 3 inches in length, this body commences by two roots attached to the ischial arch, and which are covered each by a rudimentary erector clitoridis muscle. Thence it projects as a rod upwards and backwards in a small recess at the inferior commissure of the vulval opening. Its free extremity is enveloped in a mucous cap—the preputium. Towards the centre of this extremity is a small pit containing sebaceous matter. The mucous membrane covering it is usually dark-coloured or marbled, though in white mares it may be colourless. The clitoris is composed chiefly of erectile tissue. It is more especially the seat of venereal excitation during coition; it is frequently erected at that time and during œstrum. It is abundantly supplied with nerves, which endow it with the most acute sensibility. Its function is not, however, very important; it has no marked action on œstrum or fecundation. In the mare it is frequently removed for the relief of nymphomania, but the results are not certain.

The *Meatus Urinarius* is the opening of the urethra into the vulva. It lies in the middle line on the floor of this canal in the mare, about 4 to 6 inches in front of the outer opening.

It will admit the entrance of two or three fingers. It is protected above by a horizontal fold of mucous membrane, the valve of the meatus urinarius, the free border of which is directed backwards. The object of this fold is to direct the flow of urine backwards to the exterior. The large size of this opening predisposes to prolapse and eversion of the bladder, which is more common in the mare than in any of the other domesticated mammals. The urethra from this opening passes downwards and forwards beneath the vagina to the urinary bladder.

The *Hymen* is a transverse membranous partition between the vulva and vagina. It lies immediately in front of the meatus urinarius. It is due to the persistence of the partition between the termination of the hind-gut and the proctodeum of the embryo ; as a rule it disappears in our animals before birth. When present, it is perforate, and usually consists of a membranous band connecting the floor with the roof of the genital passage. In white and grey heifers it is commonly persistent and imperforate, causing the retention of utero-vaginal secretions (white heifer disease). Occasionally the remains of the septum are noted as little pedunculated appendices in front of the meatus urinarius.

In the *cow* the lips of the vulva are larger, softer, and thicker, than in the mare, and the inferior commissure, angular and prolonged into a curved peak, is furnished with a tuft of hair. On the floor of the meatus a digital pit or infundibulum is placed. It must be kept in mind when passing the catheter. Two large almond-shaped glands, the vulvo-vaginal glands (S. Bartholini), lie under the mucous membrane on the floor of vulva, and their ducts open about 1 inch in front of the external genital opening. The clitoris is longer and more slender than in the mare. The vulva is so narrow in the heifer that it is often impossible to pass the hand into the vagina.

In the *sheep*, which has not copulated, a riband-like band is frequently present to represent the hymen.

In the *pig* the inferior commissure is acute, and the meatus urinarius is not protected by a valve.

In the *bitch* and *cat* the vulval opening is triangular, the inferior commissure is acute. The urethra opens on a depression without a valve. In the cat a small cartilage or

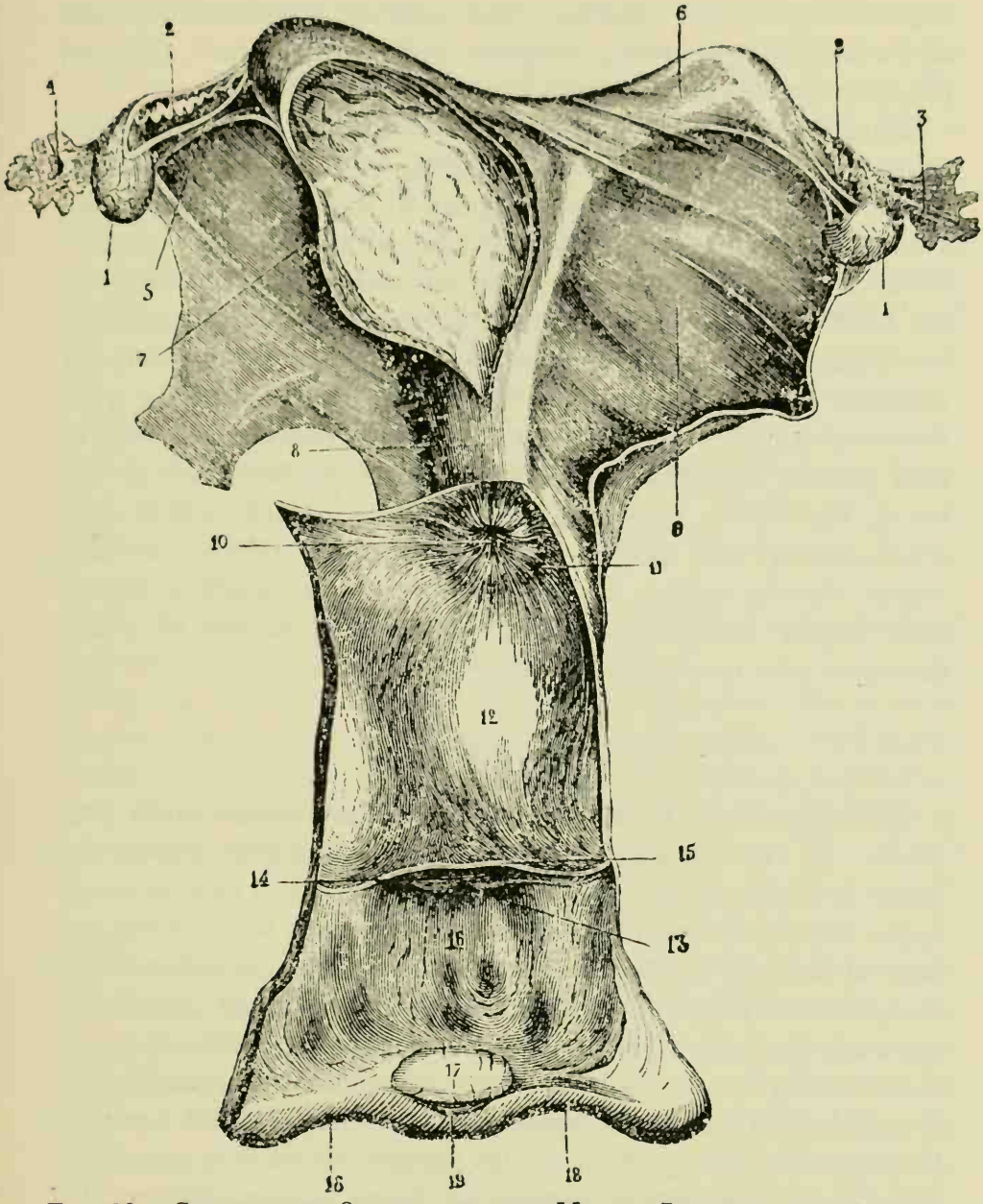

FIG. 20.—GENERATIVE ORGANS OF THE MARE: ISOLATED AND PARTLY OPENED. (CHAUVEAU.)

1, 1, Ovaries; 2, 2, Fallopian tubes; 3, pavilion of the tube, external face; 4, *ibid.*, inner face, showing the opening in the middle; 5, ligament of the ovary; 6, intact horn of the uterus; 7, a horn opened; 8, body of the uterus, upper face; 9, broad ligament; 10, cervix, with its numerous folds or *palma plicata;* 11, cul-de-sac of the vagina; 12, interior of the vagina, with its folds of mucous membrane; 13, urinary meatus and its valve, 14; 15, mucous fold, a vestige of the hymen; 16, interior of the vulva; 17, clitoris; 18, 18, labia of the vulva; 19, inferior commissure of the vulva.

bone exists in the clitoris. The interval between the anus and vulva, the perinæum, is much wider in the bitch, cat, and pig, than in the larger animals.

The internal limits of the vulva are defined by the constriction of the vaginal bulb, which forms a marked prominence in early life, but tends to disappear in relaxed folds after the animal has brought forth young several times. The dimensions of this aperture are rather adapted for the passage of the fœtus than the penis, though its narrowness is sometimes an obstacle to delivery in a primipara. The limbs, body, or head, of the fœtus are at times arrested at the superior commissure, which they so distend as to threaten laceration of that part. In emaciated animals, and particularly in the mare, the vulva is deeply retracted above the ischia, and consequently this predisposes them to be injured in this region during coitus, by the accidental introduction of the male organ into the anus, the mechanical action of which damages, and may even rupture, the rectum.

The Vagina.

The *Vagina* is a musculo-membranous canal with thin walls. It extends almost horizontally backwards within the pelvis from the cervix uteri to the vulva. It is related above to the rectum and sacrum, below to the bladder and urethra and floor of the pelvis, and laterally to the ureter and side-walls of the pelvis. When distended it is cylindrical, but usually its sides are in contact. It varies in length from 9 to 10 inches. It is covered in its anterior two or three inches by peritoneum, and is attached at its lateral borders by the uterine broad ligament to the roof of the pelvis. In its posterior part it is connected with the neighbouring organs by loose fibrous tissue. Internally it is lined by a thin, smooth, rose-pink mucous membrane disposed in longitudinal folds or rugæ, which are more conspicuous after several births. These folds favour the dilatation of the canal during copulation and parturition, so that the vagina may be ballooned almost to the size of the pelvis. The ballooning of the vagina may be induced also by the injection of various tepid fluids and by manipulation, and probably increases the safety of copulation by rendering it

impossible for folds of the mucous membrane to become caught by the penis and injured. This membrane at the anterior extremity is reflected from the cul-de-sac of the vagina over the cervix of the uterus, which projects like a knob into the cavity. On the outside of the mucous membrane the vagina is invested with a thin muscular coat.

The vagina serves for copulation and the passage of the fœtus.

In the *cow* the vagina is longer and wider, the mucous membrane is thicker, and is disposed in transverse rugæ, and at each side of the passage a mucous canal, "the canal of Gaertner," extends between the mucous and muscular layer.

These canals begin in cul-de-sacs in the uterine broad ligament, and open posteriorly into the genital passage in front and at the side of the meatus urinarius. Their use is not known. They are usually absent in the sheep, goat, bitch, cat, and mare.

In the *pig* the canals of Gaertner are present; the folds of vaginal mucous membrane are longitudinal.

In the *bitch* or *cat* the vagina is long, and its mucous membrane is thrown into longitudinal as well as transverse folds. In both animals the canal is wider towards the vulva, and the walls are strengthened by a considerable quantity of white fibrous tissue.

The Uterus.

The *Uterus*, or womb, is an elongated musculo-membranous sac which receives the ovum, and constitutes the receptacle for the nutrition, development, and finally the expulsion, of the fœtus. It lies partly in the abdomen and partly in the pelvis. The whole uterus is shaped like the letter **Y**. Its posterior portion, the body, is a simple cylindrical reservoir, about 5 to 8 inches long, slightly flattened above and below, while the anterior portion is bifid; the two divisions, the cornua or horns, curve upwards and forwards. Each cornu is about 9 or 10 inches long. The body is in contact above with the rectum, below with the bladder and pelvic flexure of the double colon, and in front with the intestines. It is covered with peritoneum, and at the sides is attached to the roof of the pelvis by the uterine broad ligaments. It is continuous in front with the horns or cornua, and behind it is

continuous with the vagina. In its latter portion it is constricted—the col, cervix, or neck, of the uterus.

The cornua are cylindrical tubes lodged among the intestines in the sublumbar region, and attached along the upper concave border to the roof of the abdomen by the uterine broad ligaments. The lower border is convex and free. The posterior extremity of each horn is continuous with the body; the anterior extremity forms a round cul-de-sac, which has at its bottom a small tubercle on which the Fallopian tube opens.

The *Uterine Broad Ligaments* are double folds of peritoneum which suspend the ovaries and Fallopian tubes at their anterior border, and posteriorly the uterus and vagina from the roof of the abdomen and pelvis. They are also called alæ vespertilionis, from their general resemblance to the wings of a bat. They are wider in front than behind, and in passing backwards they converge towards the middle line. A small narrow band passes from this ligament to the internal abdominal ring, and contains a thin muscular band analogous to the round ligament of woman. These ligaments are stretched considerably in version or inversion of the uterus.

The Interior of the Uterus.—The cavity of the body communicates with the vagina by a narrow canal which traverses the constriction or cervix of the uterus, the canal of the cervix. The cervix is prolonged into the vagina like a tap into a barrel. On this projection is found the opening leading from the vagina into the body of the uterus (os uteri). Around this aperture the utero-vaginal mucous membrane is arranged in ridges radiating from the centre, and present the appearance of a flower. The dimensions of the cervix and os uteri vary very much; usually one can pass one or two fingers into the os. During œstrum the os uteri is usually dilated, and will admit the entrance of three or four fingers, or even the entire hand. Occasionally the walls of the cervix are so flaccid as to interfere with fecundation, and more rarely the os uteri is so constricted as to prevent the entrance of semen to the uterus, and so sterility results. At the time of parturition the constriction at the cervix uteri disappears, and the uterus and vagina form a single undivided canal.

The uterine wall consists of three layers: the outer serous,

the middle muscular, and the inner mucous. The muscular layer consists of circular and longitudinal non-striped fibres; the circular fibres are particularly numerous at the cervix. During gestation these fibres are increased in size and number, to permit the necessary dilatation of the uterus, without allowing its walls to become too attenuated and feeble. The outer layer is composed of longitudinal fibres, which determine in their contraction the shortening of the uterus, pushing the fœtus at parturition towards the os uteri. The inner layer is circular, and decreases the lumen of the uterus. Between these two layers are intermediate bundles of fibres, oblique in direction, producing intermediate effects.

The mucous layer is smooth, delicate, and pink in colour. It is everywhere in contact in the non-pregnant condition, and it is arranged in longitudinal folds or rugæ. These folds become obliterated during gestation. It is covered with ciliated epithelium, save at the neck, where the epithelium is pavement. This membrane is provided with numerous branched tubular glands (the utricular glands), microscopic in size. At certain periods, as during œstrum, they throw out a large quantity of very viscid, almost transparent mucus. During gestation they become largely developed, and furnish a thin, white albuminous fluid, the so-called 'uterine milk.' This secretion comes more particularly in contact with the intervillous portions of the fœtal placenta, in which pockets are formed for the reception of the milk, which is absorbed by the vessels in their walls.

In the mucous membrane of the cervix are special tubular glands, the blind extremities of which are enlarged, called the ovula Nabothi; they secrete a mucous plug to close the os uteri during gestation.

The uterus is supplied with blood by the ovarian, uterine, and vaginal arteries in the uterine broad ligaments; and from it the blood is carried away by corresponding veins. The lymphatic vessels issuing from the organ pass to the sub-lumbar lymphatic glands; the nerves are derived from the small mesenteric and pelvic plexuses.

When the gravid uterus increases in volume, it pushes the pelvic flexure of the double colon before it as it advances into the abdominal cavity, on to the floor of which it gradually

descends, and rests until the termination of pregnancy. In its descent it carries with it the cervix uteri and vagina, which is considerably lengthened, the traction being extended even to the vulva, this appearing to be buried between the ischiatic tuberosities towards the end of pregnancy.

In the *cow* the uterus does not extend into the abdomen beyond a transverse line drawn 2 inches in front of the external angle of the ilium. The concave border of the uterine horn, which is attached to the broad ligament, is directed

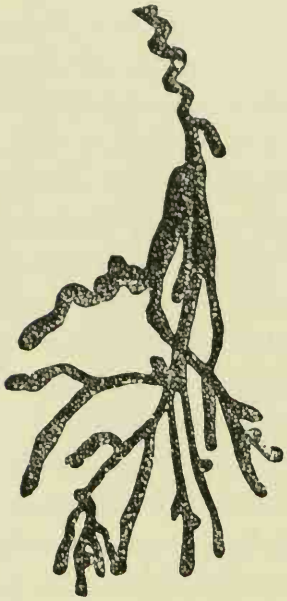

FIG. 21.—UTRICULAR GLAND OF A PREGNANT GOAT. (FRANCK.)

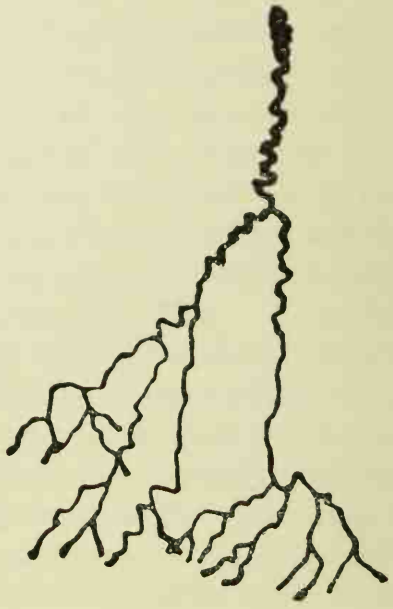

FIG. 22.—UTRICULAR GLAND OF A PREGNANT COW. (FRANCK.)

downwards, this being due to the cornu being revolved on its long axis upwards, and to the outer side of the ligament. Because of the continuity with the body, the base of the horn does not present so much deviation as the anterior extremity. As the fœtus develops in the uterine cornu, this peculiarity in its position and attachment explains the frequency of torsion of the organ during pregnancy. The cornua are thin and tapering at their anterior extremities, and the body is narrow and not more than about 1 inch long. The cervix uteri is 3 to 4 inches in length and circular in section, and its walls are thick and almost as rigid as cartilage owing to the contraction of its circular muscular fibres. The cervical canal is very narrow

and curved in its length. It will admit only the passage of a fine catheter and is difficult to dilate mechanically. It increases in calibre during œstrus. The mucous membrane presents not only longitudinal but also transverse folds. These transverse, or circular, folds are firm and are directed backwards. Their free borders carry little projections, which become very large and prominent in cervicitis. In the virgin heifer the transverse folds are four in number, the most posterior forming the border of the os uteri externum. The cervix projects as a rounded knoblike projection into the vagina, in the centre of which lies the outer opening of the cervical canal (os uteri). In cows which have had several calves this posterior fold of the cervical canal is obliterated, and the fold which lay in front of it forms the border of the os uteri externum.

The wall of the uterus is thicker than in the mare. The mucous membrane is raised into rounded smooth prominences known as caruncles or uterine or maternal cotyledons. They are most numerous in the cornua, few and small in the body, and vary from sixty to one hundred and twenty. In heifers they are only about the size of beans, but during gestation they increase up to the size of hens' eggs. They vary in shape, are slightly convex on the surface in the cow, but concave in the ewe and goat, and are pale in colour save during gestation, when they become reddish-yellow from the afflux of blood to them. To them the chorion or placenta of the fœtus is attached. They are disposed in longitudinal series, four series near the body of the uterus, two at the anterior extremity, and three in the middle of the cornu. Each cotyledon is attached to the mucous membrane by a narrow pedicle, and in removing the fœtal placenta after parturition care has to be taken not to tear them off.

The utricular glands are wider than in the mare, and have lateral diverticula. In the cotyledonary parts the glands are absent.

In the *sheep* and *goat* the uterus is similar to that of the cow, save for the appearance of the cotyledons already referred to.

In the *pig* the uterine cornua are long and tortuous, and float among the intestines, which they resemble; the body of the uterus is very short. The numerous irregular longi-

tudinal ridges on the mucous membrane of the cornua gradually subside towards the cervix, where two or three series of thick, soft rugæ are formed. The cervix uteri does not project into the vagina. The broad ligaments resemble the mesentery in appearance.

In the *bitch* and *cat* the cornua are similar to those of the

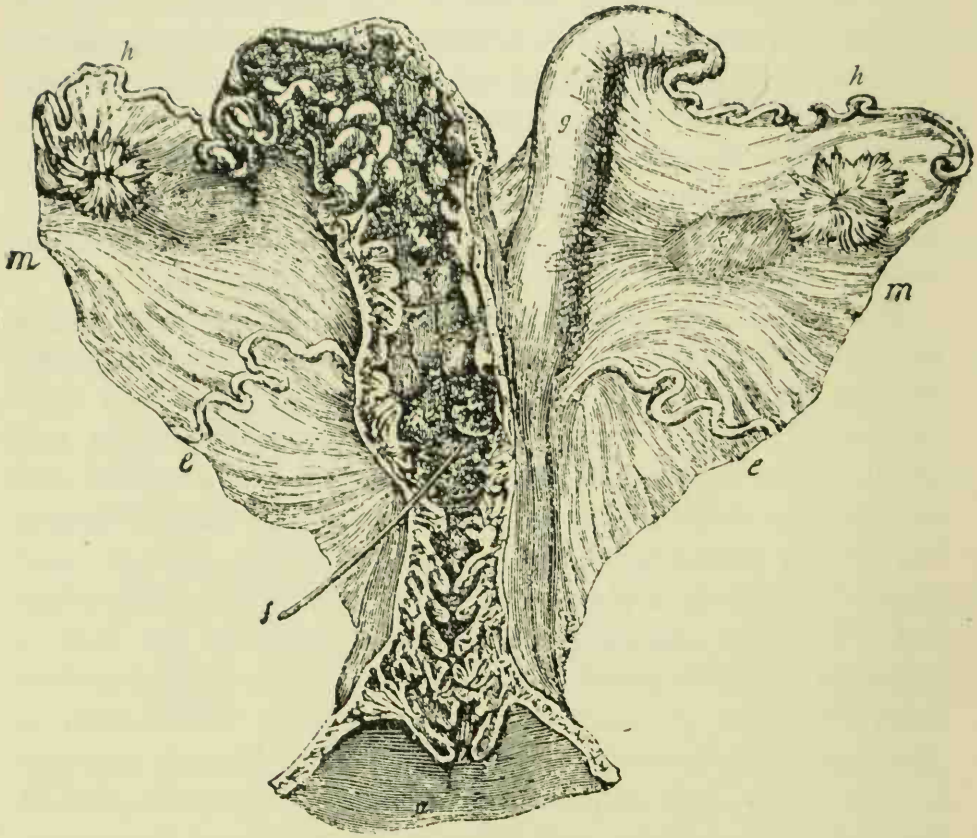

FIG. 23.—UTERUS, OVIDUCTS, AND OVARIA, OF THE SHEEP. (OWEN.)

a, Vagina; *b*, os uteri; *c*, transverse folds of cervix uteri; *d*, body of uterus; *e*, *e*, caruncles or cotyledonal processes; *f*, confluence of the cornua; *g*, intact cornu; *h*, *h*, oviducts or Fallopian tubes; *i*, *i*, fimbriæ; *k*, *k*, ovaries; *l*, round ligament; *m*, *m*, broad ligaments; *n*, *n*, cotyledons.

pig, but are straight; they unite externally for nearly 2 inches before they join the body of the uterus. The cervix uteri forms a smooth, thick prominence. The body of the uterus is very short.

The cornua vary in size according to the dimensions and species of the different animals. In those which generally bear one at birth (uniparous), the cornua are short; the fœtus is usually developed in the body and one of the

cornua of the uterus. In those which generally produce more than one at birth, the cornua are long in proportion to the number of young they bear; while the body is short, the cornua resemble the intestines in appearance, and the young are developed in them, the body of the uterus seldom containing any. After parturition the uterus gradually diminishes in size, and some of its supplementary structures disappear, but it never resumes its previous volume.

The Fallopian Tubes.

The *Fallopian Tubes*, or *Oviducts*, are two small, white, cylindrical, flexuous canals, about 10 inches long, and of about the thickness of a knitting-needle. One is placed at the anterior border of each broad ligament. It opens posteriorly on a small tubercle into the anterior extremity of the horn of the uterus by a small opening, the ostium uterinum. It gradually increases in width to its anterior extremity, where it is placed on the outer aspect of the ovary near the hilum, or ovulation fossa. Here it opens into the peritoneal cavity on the centre of an expansion the edges of which are cut into a number of unequal fringe-like prolongations. From the opening the mucous membrane is raised in folds, which radiate towards the periphery. By this opening the peritoneal cavity has a remote communication with the exterior through the uterus and vagina, but this passage is never or seldom likely to be a means by which bacteria or fluids will gain the peritoneum from the uterus. This expansion is fixed at its inner edge to the ovary. The wall of the tube is composed of three layers—the outer serous, the middle containing circular and longitudinal non-striped muscle fibres, and the inner mucous layer. This latter layer is arranged in intricate longitudinal folds, and is lined with a ciliated epithelium. The oviducts are supplied with blood from the ovarian arteries, and with nerves from the ovarian plexus.

When the Graafian follicle of the ovary is about to rupture, the fimbriæ of the Fallopian tube grasp the ovary over the follicle, and after rupture the ovum escapes into the Fallopian tube, and is carried back by action of the cilia and the muscular coat towards the uterus. The seizure of the ovum by the

Fallopian tube is all the more certain in proportion as the fimbriated extremity is large enough to grasp a large surface of the ovary; it is found most developed in carnivora. Here probably also the ovum is fecundated with spermatozoon. In some few cases fecundation takes place at the ostium abdominale, and the ovum escapes into the peritoneum, where it develops, and extra-uterine gestation results. The ovum normally is carried to the uterus, where its further development takes place, if it is fecundated either in the Fallopian tube or horn of the uterus.

In the *pig* the tube is proportionally longer than in the

FIG. 24.—OVARY OPENED VERTICALLY. (SAINT-CYR.)

Showing opened Graafian follicles.

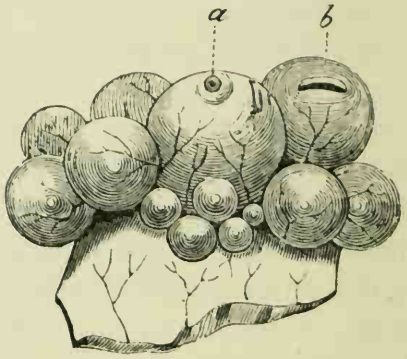

FIG. 25.—PORTION OF THE OVARY OF A PIG. (SAINT-CYR.)

a, Point at which a ripe vesicle is about to escape; *b*, fissure by which an ovule has escaped.

other species. In *ruminants* and the *sow* it is readily seen underneath the peritoneum without dissection; in the *bitch* frequently a great quantity of fat surrounds the Fallopian tube.

The Ovaries (Right and Left).

The *Ovaries* (testes muliebres), the essential organs of generation in the female, are two ovoid or reniform bodies, each being about the size of a hen's egg, of firm consistence, of a livid colour, smooth on the surface, and about 1 to 3 ounces in weight. They are loosely suspended in the sublumbar region, behind the kidneys by the uterine broad ligaments, and float above among the small intestines and colon. They lie about 3 inches in front and below the level of the external angle of the ilium. Each ovary presents on its outer side a distinct

notch or hilum, or ovulation fossa, near which the Fallopian tube is attached. The ovary is attached to the horn of the uterus by a distinct muscular band, the ovarian ligament.

Each ovary is covered by a layer of germinal epithelium, from which the ova and Graafian follicles are derived. In the old mare this epithelium is replaced by the endothelium of the peritoneum. The stroma of the organ is firm, and consists of a spindle-celled tissue, in which are embedded the

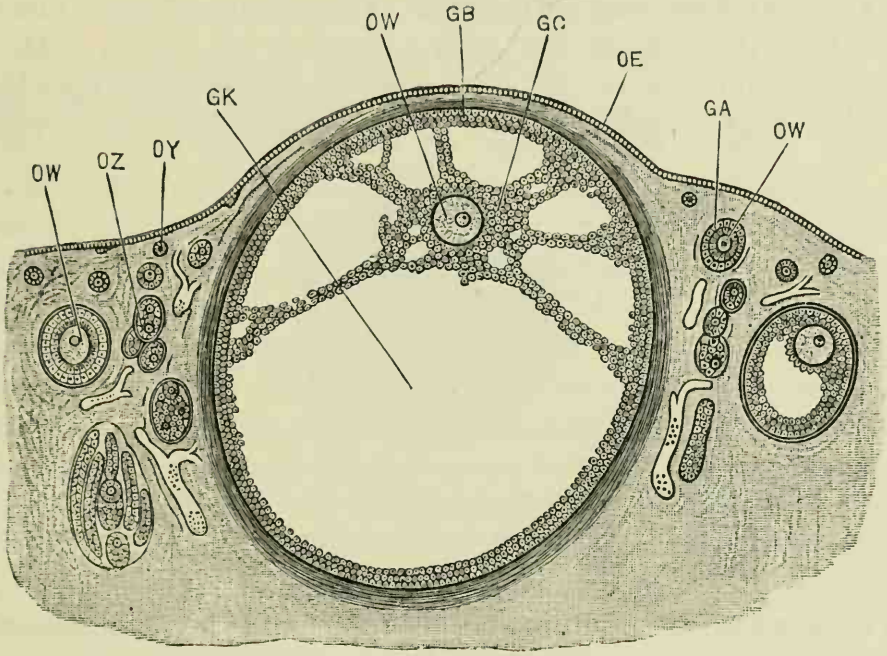

FIG. 26.—GRAAFIAN VESICLE AND OVUM IN OVARY. (MARSHALL'S "EMBRYOLOGY.")

CA, Follicle cells surrounding ovum; OW, ovum; GB, zona granulosa; GC, discus proligerus; GK, cavity of Graafian follicle; OE, germinal epithelium; OY, primitive ovum.

Graafian follicles. These follicles vary in size; when young they are microscopic, and lie in the stroma under the epithelium, but as they enlarge they pass inwards. When fully developed, each follicle attains the size of a pea or a bean, and bulges on the outer side of the ovary. It appears as a vesicle with clear, straw-coloured albuminous contents, the liquor folliculi. It is covered by a layer of fibrous tissue continuous with the stroma (theca folliculi), within which is placed a cellular layer, zona granulosa, the outer coat proper

to the follicle. This layer immediately encloses the cavity. At one side is attached a stalk of cells connected with a rounded mass of a similar nature (discus proligerus), which surrounds the ovum. There is usually only one ovum to each Graafian follicle; occasionally two are present. Ova are claimed by Nagel to be developed, not only in the ovary proper, but also in the tissue in its immediate neighbourhood, in the region of the oviducts. It is possible that that may explain the recurrence of œstrum in some cases after ovariotomy has been performed. The mature ovum is one of the largest cells in the body, rounded in shape, with a spherical nucleus or germinal vesicle and distinct spot-like nucleolus or germinal spot. Its protoplasm (vitellus or yolk)

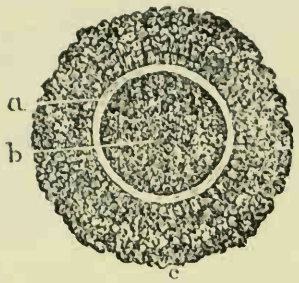

FIG. 27.—OVULUM OF THE MARE. (FRANCK.)

a, Zona pellucida; *b*, vitellus, containing the vesicula germinativa; *c*, cells of the discus proligerus.

is charged with albuminous granules and fat globules to nourish the embryo during the early portion of its development, before its attachment to the uterus. The ovum is surrounded by a thick, tough, clear, cross-striated membrane, the zona pellucida or radiata (permanent ovum). The size of the mature ovum in the cow is $\frac{1}{250}$; pig, $\frac{1}{200}$; cat, $\frac{1}{180}$; bitch, $\frac{1}{160}$; rabbit, $\frac{1}{150}$, of an inch. The ovaries are supplied with blood by the ovarian arteries, which is removed by corresponding veins. The lymphatics pass to the sublumbar lymphatic glands, and the nerves come from the ovarian plexus.

In the *cow*, *sheep*, and *goat*, the ovaries are relatively smaller than in the mare, they are commonly pelvic in position, and may be found on rectal examination at the outer side of the uterine horns. In the *cow* they are ovoid in shape, and about $1\frac{1}{2}$ inches long and are situated about 18 inches distant from the vulval opening at the edge of a transverse fold (uterine

broad ligament) in the anterior portion of the pelvis. The mature Graafian follicles and corpora lutea can readily be distinguished on their exterior as distinct prominences.

In the *pig* the ovaries are comparatively large, and appear like miniature bunches of grapes, owing to the large Graafian follicles projecting on the surface of the ovary (Fig. 25).

The ovaries of the *bitch* and *cat* have short ligamentous attachments, and are enclosed in small peritoneal pockets, or sacs.

Development of the Ovaries and Ova.

The ovaries appear early in embryonic life ; they may be seen at one month in the foal or calf, or forty-two days in the lamb. They appear first as longitudinal ridges, which develop on the Wolffian bodies as a result of proliferation of the endothelium of the peritoneum. For a time the genital ridges are alike in both sexes, but later the differentiation is established. In the mare the ovaries of the fœtus are very large, and at six months are almost as large as in the adult. In aged animals they atrophy, and in some cases become cirrhotic or cystic. From the germinal epithelium covering the ovary the Graafian follicles are formed. These are produced as ingrowths into the stroma—tubes of Pflüger. Each of them becomes separated from the germinal epithelium, and the ovum is arranged as a round cell in the centre of a mass of smaller cells. These Graafian follicles are present in the ovary of the fœtus, but they do not attain their full development until puberty ; all permanent ova are probably formed at or shortly after birth in all domesticated mammals. Once formed, they may live in the ovary during the whole of the sexual life of the animal—say, in the mare, up to twenty or twenty-five years.

The actual number of ova in the ovaries is not ascertained, but probably runs into thousands, of which the large majority never reach maturity, but undergo retrogressive changes. The follicles and ova develop in series, and the frequency of ovulation varies with species, climate, and degree of domestication. In cattle which are not pregnant, ovulation occurs every three weeks throughout the year.

As the follicles develop they pass towards the centre of the

ovary. A cavity begins to form, in which the follicular fluid accumulates. As each follicle enlarges, the ovum correspondingly increases in size. The wall of the follicle which separates the cavity from the exterior of the ovary gradually thins down.

At the period of œstrus, or "heat," one or more vesicles, according to species—usually one in mare and cow, two or three in ewe and goat, and as many as four to twelve in sow and bitch—rupture, and the ova are discharged usually into the oviduct; very rarely do they fall into the peritoneum. This development and discharge of the ovum is called ovula-

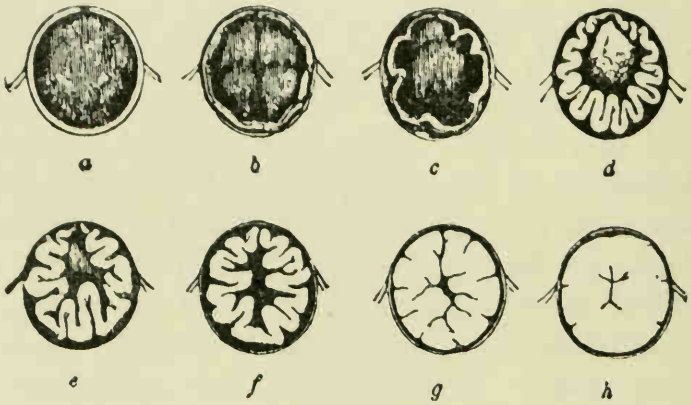

FIG. 28.—SUCCESSIVE STAGES IN THE FORMATION OF THE CORPUS LUTEUM IN THE GRAAFIAN FOLLICLE OF A SOW: VERTICAL SECTION. (POUCHET.)

a, Follicle immediately after the expulsion of the ovum, its cavity being filled with blood, and no ostensible increase of its epithelial lining having yet taken place; at *b* a thickening of this lining has become apparent; at *c* it begins to present folds, which are deepened at *d*, and the clot of blood is being absorbed and decolorized; a continuation of the same process, as shown at *e*, *f*, *g*, *h*, forms the corpus luteum, with its stellate cicatrix.

tion. In some mammals—*e.g.*, in the rabbit—the rupture of Graafian follicles is determined only by copulation under natural conditions. The number of Graafian follicles which come to maturity and rupture at each period of œstrus depends, with some exceptions, upon the number of young each female brings forth at birth.

These follicles in multiple ovulation do not appear to rupture simultaneously, but successively. After rupture, the cavity of the Graafian follicle becomes filled with blood, as the result of hæmorrhage from neighbouring capillaries which have given way. The blood clot is soon absorbed and its place is

taken by enlargement and proliferation from the cells of the zona granulosa, and by ingrowths of connective tissue from the theca folliculi. The cells of the zona granulosa form the lutein cells. In this way the corpus luteum is formed. At first it is only about half the size of the original Graafian follicle, but it rapidly enlarges, to attain its full size about the middle of the interval between the œstrous periods. It is at first somewhat round and soft, and it soon becomes yellow to orange-brown. It is solid or contains a little albuminous fluid in the centre. In the cow or heifer it attains the size of a hazel nut, and often forms a small pimple-like projection on the surface, and can readily be enucleated by manipulation between finger and thumb per rectum. If the ovum is not impregnated the corpus luteum gradually atrophies, and its place is represented by a reddish-yellow spot by the time the next follicle is mature. Should it persist, it inhibits ovulation and œstrus. In the cow or heifer the enucleation of the corpus luteum from the ovary by rectal manipulation brings on the appearance of œstrus within two or three days.

There is no essential difference between the corpus luteum of menstruation or œstrus (the so-called false corpus luteum) and the corpus luteum of pregnancy.

In a pregnant animal the corpus luteum persists throughout pregnancy at its maximum size, and atrophy only occurs at or after parturition. Apparently this organ, by its internal secretions or hormones, exerts a very important influence upon gestation. Abortion is invariably brought about in pregnant cows or heifers after an interval of one to three days by squeezing out the corpus luteum from the ovary, and in practice this is the simplest way of inducing abortion. In the rabbit the removal of the corpus luteum from the ovaries, in the first half of pregnancy, was followed by fœtal atrophy and absorption, and by abortion in the second half. Ovulation usually ceases during pregnancy, and probably in that way the permanent ova are preserved in pregnant animals more than in non-pregnant, where the intervals between the periods of œstrus is less than the length of gestation.

In old animals the permanent ova disappear from the ovaries. They are either cast off or atrophy, and the ovaries also decrease in size. These animals can therefore not be bred from, and generally lose their sexual desire.

CHAPTER II

OBSTETRICAL PHYSIOLOGY

REPRODUCTION.

The sexual organs are essentially concerned in the propagation of the species, the conception, intra-uterine development, and preservation, of the young animal for a certain period, in its expulsion at parturition and its nourishment for some time after birth, until the young animal is quite capable of an independent existence. In order that generation should take place in the higher class of animals, in which the sexes are separate, it is necessary that the two sexes be placed in favourable relations with each other. This preliminary condition is indispensable, as the first essential of reproduction is the fusion of the spermatozoon in the male fecundating fluid with the ovum of the female. Nature has ordained that this creative act should be accomplished by engendering in those animals an instinctive and irresistible desire for copulation at a certain stage of existence; which desire, continuing only for a brief period, is renewed after particular intervals, until the faculty of reproduction ceases.

The processes, then, by which generation is accomplished are four: copulation, fecundation, gestation, and parturition; but it is only on the attainment of a certain age—that of puberty—that these sexual acts are in activity, and they continue so for a variable period, according to species. After the spermatozoon has fused with the ovum—*i.e.*, after the ovum has been fecundated—it is received into the uterus, and remains there for a regulated period, during its development into the young creature possessing certain physical attributes and resemblances to its parents. This is the gestation period, and is followed by that of parturition, when the young is born.

Puberty.

The generative organs of the domesticated female animals are only in a state of greatest activity during the prime of life, and then their functions are periodic. These functions lie dormant from birth until puberty, when, somewhat suddenly, certain very marked modifications occur throughout the whole organism, but particularly in the generative organs of the male and female animals. In the former the testicles become more voluminous, and in some species they leave the abdominal cavity to be lodged in the scrotum. They begin to form spermatozoa, small cells shaped like miniature tadpoles, and capable of free and active movement. The accessory glands form a medium in which these organisms may swim and be carried, and the penis, the organ for the conveyance of this spermatic fluid to the female, becomes more developed, and is capable of complete and frequent erection. In the female the mammæ enlarge, the ovaries are more vascular and turgid-looking, and the Graafian vesicles are more or less developed. Periodic ovulation then begins to be carried on, and with it œstrus is seen.

The age at which animals arrive at puberty or sexual maturity is not only different in different species, but is influenced to some extent by the rapidity of their growth and the duration of their life. Domestication, by inducing a more rapid development of the organism, has hastened the advent of this period. Puberty is sooner attained in the female than in the male. In the latter the generative functions are then always more or less in activity.

The aptitude to procreate, though generally admitted as an indication of adult age, yet appears before animals have attained their full physical development, and is present in some creatures at a comparatively early period of life, depending on climate, food, and other circumstances. The pig may conceive when only 4 or 5 months old; the sheep and goat at 8 to 12 months; the bitch at 7 to 10 months; the cat at from 8 months to 1 year old—is usually in heat for about ten days before it is a year old; the cow at 12 to 18 months; the mare at from 1 to 2 years. Mares

have been known to foal at 30 months (Saint-Cyr) and at 22 months.

Heifers have taken the bull at 5, 6, 7, and 9 months, and calved at 14, 15, 16, and 18 months. Saint-Cyr gives the period of puberty as commencing in the equine species at from 15 to 18 months; in the bovine species at from 12 to 14 months; in the porcine species at about 8 months; and about the same time for the ovine and caprine species, the canine species being a little earlier.

It is recorded in the first volume of the *Lancet* (1835-36) that a quey calf about two months old copulated with a bull calf less than three months old, and gave birth within nine months to a calf. Quey and calf did well.

With regard to the period when procreation ceases in animals, no reliable data are to hand. The mare has not ceased to breed after 30 years of age—even up to 38 years—and sheep have bred beyond 20 years, the cat beyond 14 years. At the same time, although puberty may last for such a length of time, it is an exceedingly difficult thing to breed from an aged female that has not previously been used for stud purposes. The changes incidental to the procreative period in the female are chiefly centred in the ovaries and uterus. The ovaries are the essential and principal organs giving the necessary stimulus to the condition termed "œstrus," and furnish the ovum which has been, or is intended to be, fecundated; while the uterus secretes mucus and the peculiar fluid ejected, receives the ovum, forms the decidual temporary or enveloping membranes in some cases, nourishes the fœtus, and finally expels it. The ovaries and uterus thus co-operate in the accomplishment of the four chief functions of the uterine system, viz., œstrus, conception, gestation, and parturition.

Œstrus, or Heat.

Heat, or œstrus, marks the period of maturation of the ovum, according to species. This condition is intermittent or periodic, not continuous. It is characterized by a peculiar systematic excitement that usually continues for a somewhat definite period. The genital organs become swollen and

vascular, and there is a more or less profuse discharge of mucus from the vulva, which may be blood-stained. The animal is fevered and irritable; its sensibility is increased; the appetite is more or less in abeyance or capricious, and usually there is thirst. If the secretion of milk has been active, it now diminishes. In the non-impregnated bitch milk even appears in the mammæ. Restlessness is a notable feature, and the movements betray the prevailing desires. There is an uncontrollable tendency to seek the opposite sex. With some animals the ordinary disposition becomes strangely perverted; and in others, again, certain physical changes accompany the sexual perturbation. The mare is usually irritable or sluggish, and less liable to sustain fatigue; the cow frequently bellows and mounts other cows, and if at pasture runs about with raised tail, bellows, and mounts other cows, or stands to be mounted, and may even wander away in search of the bull. In the house the symptoms of heat in the cow are less marked than at grass and may be overlooked. The sheep is less excitable, though it shows a change in its habits; the sow grunts in a peculiar manner and becomes torpid, and manifests its amorous desires by mounting others; while the bitch is still more demonstrative, and frequently runs about accompanied by a crowd of males, not returning home until her desires have been satisfied. Attempts at micturition are frequent, but only a small quantity of urine is passed, which is frequently mucoid; and with solipeds there are oft-repeated movements of the clitoris and vulva. Emissions of blood have been occasionally observed. Hysteria has been noted in the mare. In all animals the discharge from the vulva has a special and powerful odour which attracts the males and enables them to distinguish the females in heat, and excites in them the most ardent amatory desires.

During the early stages of œstrus the uterine mucous membrane becomes congested by dilatation of the capillaries; the walls of the latter may be broken down, and the hæmorrhage results into the uterine mucosa or into the cavity of the uterus. The utricular glands also secrete a small amount of mucoid fluid. The hæmorrhage is the cause of the appearance of blood in the vulval discharge, or the pigmentation of the uterine mucous membrane after œstrus. The secretion

of the utricular glands also contributes to the vulval discharge. Desquamation of the epithelium of the uterus occurs in the woman and monkey, and also to some extent in the dog, but hardly, if at all, in the mare, cow, sheep, and pig. In the lower animals blood has been noted in the vulval discharge to a more or less extent, generally not exceeding one or two ounces. A considerable amount of liquid mucus, secreted probably by the mucous glands in the cervix uteri, accumulates in the vagina of the cow, and some of it may be discharged from the vulva. Sometimes there is a little discharge of blood which may come from the vaginal mucous membrane, perhaps the uterus or both. This uterine congestion disappears in the latter stages of œstrus, when the female takes the male. The cause of œstrus is, probably, some internal secretion produced by the ovary. As a rule the removal of the ovaries prevents the appearance of heat, more especially if the animal has not arrived at puberty. In exceptional cases, however, sows, bitches, and cats, which have passed through one or more periods of heat, and then had their ovaries removed, have again come into œstrus. In some cases the recurrence of œstrus after ovariotomy may be explained by the imperfect removal of the ovaries, a small piece of ovarian tissue having been left behind. But there are cases in which there can be no doubt about the complete extirpation of the ovaries, and yet œstrus has recurred, and the animal even taken the male. Such cases can only be explained by habit, the mechanism required to bring about œstrus being easily put in action after it has been once employed. In females which are put to stud late in life, sometimes œstrus does not appear, and the animals prove barren.

The sexual seasons in animals vary very much. Probably in all wild animals œstrus appears only once a year. Domestication has increased the number and changed the time of these periods. The mare is usually in heat from February to June, or later; the bitch comes into œstrus in the autumn and springtime, or from December to February although the smaller breeds sometimes show the condition three or four times a year. Œstrus appears in the cow at any time of the year; midsummer is the more common sexual season. With the cow whose calf is sold at one or two

months old, the season of course is varied, as care is taken to induce conception again as soon as the lacteal secretion begins to diminish. In sheep, heat is naturally present in September, and may be induced at an earlier period, so as to obtain two lambings in the year. The cat is in this state in January and February, and also in the spring and autumn; sometimes the heat appears three or four times a year, and the animal may produce young as frequently. The pig manifests œstrus in October and November—at least, that is the period when it is usually put to the male; and it may be put a second time towards the end of spring, in order to have two litters within the twelvemonth.

The frequency and duration of the period of œstrus depends upon age, species, and other circumstances; but it may be said to persist in the domesticated animals from one to fifteen days at the most. The shortest period is witnessed in the cow and sheep, the longest in the bitch. With impregnation it ordinarily ceases until after parturition; and if impregnation does not occur, it gradually disappears until the next period, which is somewhat variable. Occasionally some pregnant animals—the mare, cow, and pig—manifest a desire for the male, and even copulate. The mare commonly takes the horse on the ninth day after foaling, but the date may vary from the seventh to the tenth day. Then the œstrus may last only a few hours. If it does not become pregnant the mare manifests a desire for the horse every two or four weeks from the spring until the end of summer, and the objective phenomena which announce it continue from two to four days. The cow comes into season at a variable period after parturition, usually in from four to nine weeks, sometimes earlier. When it is suckling a calf, œstrus may be deferred. The duration of heat is very short in this animal and varies from eight to twenty-four hours. Its reappearance in the cow is noted every three weeks, and may be continued until the cow conceives. In cows there are great variations in the intensity of the symptoms of heat. These symptoms are more marked when the animals are running in a herd together at grass than when in the house. In the sheep and pig œstrus lasts for one or two days, and again appears from the fifteenth to the thirtieth day, usually in the sow every

three weeks during the sexual period. The sow takes the boar about eight weeks after farrowing, and a week after weaning her litter. When removed from artificial conditions, it is stated, the ovine species is in heat in September; that this persists only for a day, but reappears every fourteen days until the end of December. In the bitch œstrus lasts nine to fourteen or even twenty-one days, and during the last seven days only does she take the dog with the best prospect of successful coitus.

The time at which ovulation, or rupture of the Graafian follicle or follicles, occurs in relation to œstrus appears to vary to some extent, but as a rule it may be said that the Graafian follicle ruptures towards the later stages. Hammond states that the rupture may not take place in the cow till twenty-four or forty-eight hours after the beginning of œstrus. The ripening of the follicles appears to occur very rapidly. Nielsen also maintains from his observations on the cow that sometimes heat is not associated with ovulation. He also observed that heat periods occurred in 5·6 per cent. of cows after conception, most frequently once, occasionally two, three, and four times. He also noted that ovulation appeared without œstrus frequently during the first two or three months after calving.

This periodicity is regulated by Nature, with a view to preservation of the species; and in animals not influenced by artificial conditions it is so arranged that the young creatures may arrive during the season when their maintenance may be best assured. Domesticity, in assuring food and shelter and easy labour, and removing the animals from the risks and alternations of an erratic life, multiplies the periodical returns of this condition. It is also favoured by the judicious bringing together of male and female, and by the use of certain substances, such as aphrodine.

Œstrus is succeeded by a period of calm even in an unimpregnated animal. In non-pregnant bitches, at the end of the fortieth to the sixtieth day, there sometimes appears (false conception) tumefaction of the mammary glands, followed by swelling of the vulva, with reddening of the vaginal mucous membrane and the escape of a viscid fluid. The animal acts as if about to bring forth—making a bed for her young; moving about uneasily; neglecting her food for

three or four days, during which the mammæ become still more developed, firm, and elastic, the teats elongated, and the lactiferous sinuses filled with an abundance of good milk, which is easily obtained by slight pressure. If a bitch in this state is presented with a young puppy, she will take to it as if it were her own, and rear it affectionately. This strange condition has also been noted, but very rarely, in the cat, and once by Chauveau in a mare.

The years during which œstrus continues vary with species, and particularly with regard to the age they attain; but it always disappears towards the decline of life.

Number of Females taken by the Male.—The stallion, if strong, will take 80 to 100 or 120 mares, and all in the space of three months. A three-year-old is restricted to 60 mares, and a two-year-old to about 15 mares.

The bull takes 60 to 80 cows, and will not be successful with more.

The shearling ram takes 40 to 50 ewes. The ram lamb takes 25 to 30 ewes. As a rule, the better the pastures, the more ewes may be taken. To be fertile, the males must not be allowed to take a larger number of females than indicated.

Fecundation.

Fecundation, or impregnation, is brought about by the fusion of a spermatozoon of the male with the ovum of the female, and this occurs naturally as the result of effective intercourse, or copulation. The seminal fluid is injected into the vagina, and probably also into the neck of the uterus. The urethral tube of the horse suggests that it is inserted into the os uteri at the time of copulation, and the pointed termination of the penis in the other animals suggests that this occurs in their case, too. In the cow the very small calibre of the cervical canal precludes the possibility of the penis penetrating through it into the uterus. That the penis need not necessarily be inserted into the uterus is shown by Williams, who cites a case in which a stallion, with a considerable portion of the penis removed, was quite as fertile after as before the operation, although it would seem that the stump of the organ could not well reach the os uteri. Probably the uterus assists

in drawing in the fluid by contracting during coitus and relaxing afterwards, so causing an aspirating action. The spermatozoa have been found in the uterus of the sheep, mare, and bitch a few minutes after copulation. Semen is often found in considerable quantity in the vagina of the cow and mare. Probably the spermatozoon travels forwards along the uterus to the horn, and even to the Fallopian tube, and there fecundates the ovum. That it must sometimes travel so far forwards as the Fallopian tube is evident from the occurrence of extra-uterine—ovarian or tubal—gestation. In the former case the spermatozoon must have even reached the ovary. The time taken for the spermatozoon to travel forwards and fertilize the ovum varies with individuals and species from some minutes to a few days. Since ovulation occurs generally towards the end of œstrus, it is probable that service is more likely to be successful when it takes place towards the end of that period. If the ovum is not fertilized, it perishes or is ejected.

Injuries during Coition.

Sometimes when a mare is not at the proper stage of œstrus, and is approached by the stallion, she attempts to kick at him, and may even cause fracture of certain bones of the limbs. This is avoided by first trying the mare, to find if she is at the proper stage to take the horse, and by hobbling her during the act.

False copulation, or entrance of the penis into the rectum instead of the vulva, occasionally occurs in the mare, more rarely in the cow and sow. It is caused by restlessness of the female, contraction of the vulva, and sometimes as the result of carelessness on the part of the groom in handling the stallion. The effect is highly dangerous. Sometimes the rectum is ruptured and the peritoneum is opened, particularly if hard fæces are present in the rectum; in this case a fatal peritonitis usually results. Where the rupture occurs in the last foot of the rectum, and the peritoneum is not opened, the animal may recover. The diet should be sparing and laxative, the fæces should be frequently removed from the wound cavity, and the latter cautiously washed out twice daily with a mild antiseptic lotion. The healing of the wound, if it does occur, is slow.

Occasionally in the young heifer laceration of the vagina has resulted from service by a large bull, and in rare cases, even rupture of the vagina has taken place at the side of the cervix. In one case observed by the editor death resulted from peritonitis.

The male, if of enormous weight, in mounting the female occasionally causes fractured pelvis, and even broken back, particularly in the cases of the mare and cow. A cow weighing 800 pounds may with safety be put to a bull weighing 2,000 pounds; but if the latter weight is greatly exceeded, the danger of fracture arises.

Infectious Diseases Transmitted by Copulation.

Infectious diseases transmitted by copulation are—

In Horses and Mares.—Influenza or pink-eye (occasionally), dourine, genital horse-pox or vesicular exanthema of horses.

In Cows.—Vesicular exanthema of cattle, contagious granular vaginitis.

In Sheep and Goats.—Contagious venereal disease of sheep and goats, some forms of contagious abortion.

In Dogs.—Infectious venereal granulomata.

Contagious Granular Vaginitis of Cattle.

Contagious Granular Vaginitis of Cattle is a specific inflammation of the vaginal and vulval mucous membrane in cows and heifers, which has been described as prevalent on the Continent of Europe, in Germany, Switzerland, Denmark, Italy, Austria, and in America, and has also been observed in Great Britain and Ireland. It is highly contagious and may affect 80 per cent. of the cows in a herd during the outbreak. It does not seriously endanger the life of the animal, but is believed to be a frequent cause of sterility, especially among heifers. It is stated that from 50 to 70 per cent. of affected cows or heifers become sterile from this cause, and it has been estimated by Thoms that the average loss per cow from this disease is about thirty shillings, because of sterility and loss of milk. It must, however, be admitted that nodular vaginitis has frequently been observed in cows and heifers in calf.

Etiology.—In 1898, Ostertag found a streptococcus forming chains of six to nine cocci held together by a delicate capsule.

The organism is present in the purulent discharges and in the mucous membrane; it grows rapidly in ordinary media. It is not yet universally accepted that this organism causes the disease. This malady is frequently transmitted by copulation; it may also be transferred directly by soiled litter, fodder, or grooming utensils, coming in contact with the vulva of the healthy cow or by attendants. In young females artificial inoculation of the vagina usually yields positive results. The disease is most intense in young animals. It is not transmissible to animals other than bovines.

The period of incubation varies from two to six days after copulation.

Symptoms.—First there appear a swelling of the labia, reddening, swelling, and tenderness, of the mucous membrane of the genital passage, and a muco-purulent discharge. In a day or two numerous small red nodules, about $\frac{1}{12}$ inch broad, develop on the vulva, at the side of the clitoris, dark and smooth on the surface, discrete, and often arranged in irregular parallel rows on the longitudinal ridges of the mucous membrane. The greater the discharge, the more numerous the nodules. Other symptoms consist of a slight fever and a loss of milk. The animal remains so affected for a month; then the symptoms subside, and the nodules, becoming paler in colour, chiefly remain for another three or four months, or more.

The penis of the bull occasionally becomes affected with the nodules similar to those on the vulval mucous membrane, and a discharge comes away from the sheath; then erection and copulation cause the penis to bleed.

Treatment.—Thorough disinfection of the diseased structures is essential. Non-irritant antiseptic douches are recommended for the vagina, such as 1 per cent. lysol, creolin, ·1 per cent. potassium permanganate, bacillol, or Lugol's solution of iodine. Antiseptic ointments and powders are also recommended. This vaginal treatment must be carried on daily, or every second or third day, for several weeks before a cure is effected. Neilsen recommends douching the vagina two or three times a week with 1 per cent. formalin solution, and immediately before putting the animal to the bull cleaning out the vagina with physiological salt solution.

Affected bulls are also treated for the sheath in the same way as the vagina of cows. Prophylaxis consists in isolation of the affected animals, careful antiseptic treatment of the sheath of the bull, and careful disinfection of contaminated stalls, destruction of litter, discharges, etc.

Infectious Venereal Tumours of Dogs.

Infectious Venereal Tumours or Granulomata of Dogs affect the genital passages of bitches and the penis and prepuce of dogs. They are most common in well-bred dogs, particularly bulldogs. The disease is widespread on the Continent of Europe, in the British Isles, and has been observed in America. It is transmitted by copulation. The cause has not yet been satisfactorily demonstrated; a spirochæte has been found in two specimens.

The first symptom shown consists of a blood-stained discharge from the vulva or prepuce; this on manipulation is shown to come from the growth on some portion of the penis of the dog or vulva and vagina of the bitch. The growth is soft, irregular, consisting of a cauliflower-like mass, generally with a broad base; the colour is red, and the tumour bleeds easily on manipulation. Experimentally the growth has been shown to attain its full size in three months; it then spreads until a large proportion of the mucous membrane is involved. Histologically the tissue is seen to be almost entirely cellular, and the cells are of the round-celled sarcomatous type.

Frequently these tumours are followed by a distinct and well-marked interstitial nephritis.

Treatment.—Dogs so affected should not be used for breeding purposes.

Curative treatment is only hopeful in the early stages or in the cases where the growths are small. After local anæsthesia and the use of adrenalin to allay bleeding, the tumours should be excised, and a little mucous membrane removed with them outside the lesions. The wounds so caused are then closed with sutures or touched with a caustic or astringent lotion or the actual cautery. In the bitch it may be necessary first to make an incision along the perinæum, and incise the wall of the vulva longitudinally in order to reach the tumours. The operation may require to be repeated in the event of recurrence

of the growths. In mild or limited cases a cure may be effected by the use of a Volkmann's curette and solid copper sulphate. After effecting local anæsthesia by the local application of cocaine and adrenalin, the growth is carefully scraped away with the curette and then solid copper sulphate applied to the raw surface. This may require to be repeated several times if there appears to be any recurrence.

Sterility, Barrenness, Unfruitfulness.

When a female does not conceive after service, it is said to be sterile or barren. Sterility may be temporary or permanent, and is far from being uncommon in some species, particularly equines and in bovines. It is difficult to ascertain the extent to which it prevails. In the Stud Book it is shown that among thoroughbred mares the percentage of those which carry foal is 73·36 ; and of those which abort or are infecund 26·64. The Royal Commission on Horse-breeding states that 40 per cent. of mares chosen for breeding fail to produce foals. In Ireland from 1925 to 1928 the average percentage of barren thoroughbred mares was 33 per cent. In the studs of France the fruitful mares are 59·57, and the unfruitful ones 40·43 per cent. At the haras of Pin, during a period of twenty years, there was a percentage of 68·27 fecund mares, abortion 5·06, and non-fecunds 26·07 ; while at the Pompadour haras, where Oriental horses were chiefly bred, the births in three years were 79·55, abortions 2·27, and non-fecunds 20·45. In the cow the fecundations appear to average about 79 per cent. With the sheep, sterility or infecundity is not so common. Rueff, at Hohenheim, found among 8,500 sheep only 740, or 8 per cent. unfruitful. Sterility is also noted at times in the dog and cat.

The causes of sterility are many and varied, but it must be confessed that they are sometimes difficult to determine, and much investigation is still required to provide the identification of some of the factors responsible for this condition and the means for their removal.

It is customary to refer to this question in terms only of the female ; but there is little doubt that in certain cases the male is really the source of the trouble. As a rule, however, this comes to light on account of the fact that the male is required

to serve a number of females, and if he is at fault an unusual proportion of the females served by him do not conceive. Under these circumstances an investigation is made into the character of the semen. If there is any defect in the ability of the male to serve properly that would at once be detected. But it is in regard to the cases where the services are quite normal and no conception follows that an enquiry would be instituted. Then it is important to examine the seminal discharge. A sample of semen is readily obtained from the vagina or uterus of the female after service. Before service, in the case of the cow, the vagina must be washed out to remove the mucus present; after service, the external genitals are washed and cleaned. The semen may then be got by drawing it up into the inseminator, in the mare from the floor of the vagina or after insertion of the nozzle of the inseminator into the uterus. In the cow it is scooped out by the clean hand from the vagina. It is then put into a sterile vessel or tube and afterwards examined. Normal semen contains enormous numbers of spermatozoa, and when kept at blood-heat they are very motile and the motility is retained for many hours. From sterile males the semen contains few or no spermatozoa and is clear and limpid, or the spermatozoa may be numerous, but are feebly motile, their heads soon become detached, or they are imperfectly formed. The fertility of the spermatozoa may be determined only to some extent by microscopic examination.

A clinical examination of the testicles, or an examination of the vesiculæ seminales and prostate gland, per rectum, may reveal some change, a chronic induration, inflammation or abscess formation. In these cases nothing can be done, nor can anything be done where no spermatozoa are present in the semen. It is, however, sometimes noted that at the first service there are few or no spermatozoa, while in a second or third service, after a short interval, the spermatozoa are numerous. The unfruitfulness in the male may be temporary and due to some recent serious disease from which an animal may readily recover after a time, while in other instances the grafting of a living testicle under the skin at some part of the body has recently been shown to have remarkable results in restoring fruitfulness.

Sterility in the male may also arise from inability to serve owing to some defects of the legs, over-fat condition, lack of exercise, debility, exhaustion from too frequent mating, paralysis of or injury to the penis, or rupture of the erectile tissue and preputial catarrh. The nature of these causes suggests that recovery in some cases may be effected by their removal. Lack of desire to serve has been treated with tonics and aphrodisiacs—*e.g.*, aphrodine, damiana, nux vomica, phosphorus, etc.

In the female the causes of sterility are many and varied, and for their determination account has to be taken of the breeding history, the conditions under which the animal is kept, as well as the direct examination of the genital organs. It will be found that at times animals remain barren even although the genital organs appear to be normal and œstrus is regular. That has often been noted in heifers. For these cases various factors have been sought to account for the want of fertility, and treatment adopted to correct any faults or defects when suspected, and where it might be thought that such defects could be corrected. The results of treatment have been very variable.

The causes of sterility in the absence of obvious structural changes are :

1. An hereditary fertility factor. The evidence on this is not clear. It is the explanation given of some "shy breeders." It is stated that the Bates' Duchess family of shorthorn cattle was noted for its low fertility, and died out from this cause.

2. Foods and feeding: (*a*) An antisterility vitamin fat soluble E has been discovered. Wheat germ oil is particularly rich in this vitamin, and it is also found, but in lesser degree, in certain cereals and in green leaves and seeds. The experiments relative to this vitamin were carried out in rats, and it is possible that this agent may prove to be an occasional factor in connection with sterility in the larger animals. (*b*) Underfed and overfed animals generally do not breed so readily as those which are in moderate condition; fat animals are especially unfruitful. (*c*) Deficiency of salts in the food That would apply particularly to calcium salts and iodine. Hence bone meal or other calcium salts including calcium iodinate are sometimes used in the hope of correcting possible

defects of this nature. A change of food or climate may sometimes effect a cure.

3. Hormonal defects. The internal secretions maintain a balance in metabolism, and if that balance is broken down by a defect in one or several of the internal secretions, sterility may be one of the results. Such internal secretions would include those formed by the interstitial cells of the ovary, the thyroid and perhaps parathyroid, suprarenal, and pituitary bodies. On that account extract of thyroid and ovarian extract are sometimes used for the restoration of fertility in the absence of gross lesions of the genital organs. Grafting of an ovary from the same species of animal under the skin of the sterile animal has also been recommended to overcome this defect.

4. Absence of œstrus or defective œstrus. This may be noted in freemartins and in retention of the corpus luteum in the cow, but it is observed in females otherwise normal.

It may be due at times to some hormonal defect of the ovary—*e.g.*, in the mare. Ovarian extract free of corpus luteum is therefore sometimes given in the belief that this agent may stimulate ovarian activity. Other forms of treatment include a suitable diet, exercise, company with male animals, and administration of aphrodisiacs—aphrodine or damiana. Aphrodisiacs may intensify the symptoms of œstrus, but they do not stimulate its production or the changes related to ovulation. They are thus only of subsidiary importance. In cows the symptoms of œstrus while the animals are in the house are often so slight that they escape notice. Other agents adversely affecting fertility include excessive lactation, debility, and debilitating disease, including foot-and-mouth disease and old age. A mare is sometimes put to the stud when aged and useless for other purposes. Attempts at breeding in such cases often fail.

5. Some defective condition of the secretions of the genital organs during œstrus which are inimical to the life and movements of the spermatozoa. These conditions are not obvious. It is stated that the mucous secretions may be acid or are too thick. In these cases it is often advised that $\frac{1}{2}$ to 1 per cent. sodium bicarbonate solution in sterile water be injected into

the vagina shortly before service, and the injection is not infrequently followed by conception and pregnancy.

DIRECT EXAMINATION.

Recognition of Abnormalities of the Female Genital Organs and their Treatment.

In all cases of sterility a careful rectal and vaginal examination should be made where possible in order to ascertain whether there are any lesions present in the genital organs and what treatment is required, or whether there is any prospect of fertility being restored.

An opinion on the latter point often requires considerable experience as well as expertness in the examination of the genitals. Before making the examination the animal should be fasted over night, and prior to that the cow or heifer should preferably be fed on dry food. The rectal examination should first be undertaken, and for doing this the nails of the hand should be clipped short and the hand and arm well lubricated with soap and water. Nervous mares should have the service hobbles applied to avoid accidents. A suitable overall should be worn during the examination, especially of the cow. The ovaries are first located and manipulated, and any change in them noted. That is more readily recognized in the cow or heifer than in the mare.

The changes occasionally noted are : want of development, tumours, or sclerosis. The ovaries are very hard in the latter case, and present no evidence of Graafian follicles or corpora lutea. Occasionally also, in cattle, the ovaries are not easily detached from neighbouring tissue owing to the presence of oöphoritis. In some cases tuberculosis is responsible for this lesion and grapes may be found in the neighbourhood. Sometimes it is due to parametritis. Inflammation of the ovary may also be due to rough handling in the act of crushing a corpus luteum. Hard, fibrous, or cystic ovaries may be benefited by massage per rectum. Cystic ovaries are sometimes felt, but there is much controversy as to what may be recognized as a cyst. A cyst in the ovary may readily be mistaken for a mature Graafian follicle, but in contrast with the latter it may be as large as a walnut; it is difficult to

rupture, and it is often associated with unusually frequent œstrus, the animal being called a nymphomaniac. Often the vertebral column at the base of the tail is directed backwards and upwards and the pelvic ligaments slackened. No doubt the cyst is really a large degenerate Graafian follicle which has failed to rupture. It may be associated with, and has been regarded as secondary to, a metritis.

In the cow the corpus luteum is easily distinguished as a moderately firm swelling of the ovary. It is frequently found in normal animals, but it is only regarded as abnormal when the animal does not come in season. The correction of the latter defect is readily made by enucleating the corpus luteum between the finger and thumb per rectum; but when the corpus luteum becomes old and fibrous it can only be squeezed out by drawing back the ovary and manipulating it per vaginam. The removal of the corpus luteum brings on œstrus and may also encourage the contraction of the uterus and removal of the contents, including any uterine exudate which may be present.

When the ovaries are cystic, the cysts should be ruptured in the same way. In the cow also one may manipulate them through the rectum, but it may be necessary to puncture them through the vaginal wall. The hopes of complete recovery in nymphomania are very moderate.

In oöphoritis, or when tumours are present, there is no likelihood of recovery.

The Fallopian tubes next call for attention. They are placed between the ovaries and the extremities of the horns of the uterus. When normal they cannot be detected. In salpingitis they may be greatly enlarged and felt as convoluted cords near the ovaries. There is no suitable treatment for this disease whatever be the cause. Sometimes it is tuberculosis in the cow, but in other cases it follows upon metritis.

Next the uterus should be examined, and first it is necessary to ascertain whether it is pregnant, even although the history is against that view. It is always necessary to remember that in the enlargement of the uterus in pregnancy the wall appears very thin and the uterine contents fluid and fluctuating, while when the uterus is enlarged in metritis the walls are thickened and hard.

The most common cause of sterility in the mare and cow is some form of metritis or uterine catarrh. On rectal examination the uterus will be found to be enlarged, in some cases to a marked degree, and not only the body but also one or both horns. In many cases there is very little change. In the normal cow which has had several pregnancies, the horns of the uterus are much larger than in the heifer and project for some distance into the abdomen. Occasionally large uterine tumours may be found. In the cow the cervix uteri calls for attention. In cases of cervicitis, the cervix is unusually large, even tumour-like, especially in its posterior part.

Then follows the vaginal examination.

In preparation for the examination and subsequent treatment of the uterus, all precautions against the introduction of infection must be taken, and all instruments sterilized before use. The instruments required for examination of the vagina and the uterus in the mare and cow are a speculum for the former and a speculum and uterine forceps for the latter. The skin around the vulva, anus, and root of the tail must be thoroughly cleansed and disinfected. The arms and hands of the operator require similar attention. So that the antiseptic fluid used—*e.g.*, 1 per cent. lysol—may not be contaminated, a bucket is filled with it and a small container with a spout on it frequently filled from the bucket and used directly for cleansing and disinfectant purposes. The lips of the vulva are then lubricated. The speculum (see Fig. 166, page 545) is then inserted into the vagina and the condition of the latter and the os uteri inspected with the aid of artificial light. An electric torch is useful for the purpose. In the mare the various lesions one may find include inflammation of the vagina, a ruptured vulva, occasionally a recto-vaginal fistula, or adhesions or stricture of the vagina which may interfere with copulation, a slight or profuse discharge from the uterus through the os uteri, a constricted or greatly dilated os uteri. In the mare this examination may be followed by a manual examination of the os uteri, and the finger even inserted into the uterus for evidence of any adhesions or tumours. The uterine discharge in the mare may be intermittent and only occasionally noted. In the cow one may find evidence of granular vaginitis, tumours in the vagina, cysts of the glands of Bartholin,

imperforate hymen as in "White heifer" disease, cervicitis as indicated by large reddened cauliflower-like growths round the os uteri, and a white or flaky discharge from the uterus. When cervicitis is present there is usually some uterine catarrh or metritis, and the cervicitis may be absent even in the presence of uterine catarrh. It is, moreover, useful in many cases in the cow to insert the hand into the vagina and draw back the cervix uteri to the vulva with the uterine forceps and then insert the speculum (see Fig. 29) to obtain a good view. With retraction even a normal cervix soon becomes reddened. In slight catarrh of the uterus massage of the uterus or the

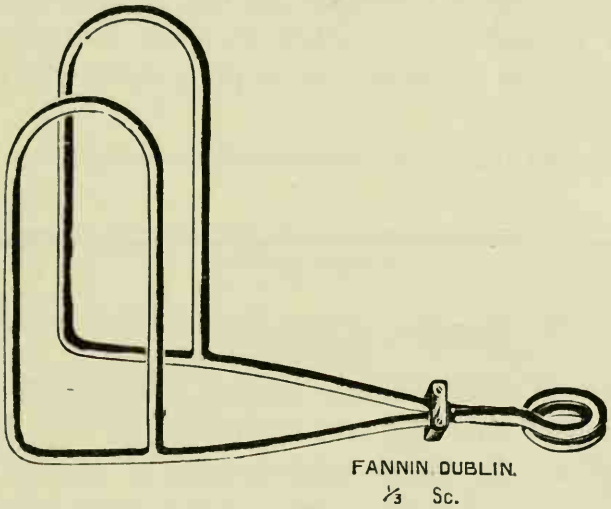

FIG. 29.—SPECULUM FOR COW.

cervix may be necessary before any white flaky discharge can be squeezed out of the os uteri. Occasionally the os uteri is double, or a vertical band connects the roof and floor of the vagina behind the os, but these abnormalities do not appear to interfere with fertility. In any case the band can readily be cut through with knife or scissors without danger of giving rise to much hæmorrhage. The lesions noted have to be considered in relation to sterility, and injuries or adhesions in the vagina, imperforate hymen, tumours, cysts, or abscesses, recto-vaginal fistula, and vaginitis treated as indicated under their appropriate sections.

In the cow stricture of the os uteri has been commonly mentioned as a bar to conception, but that belief is probably based on a misconception. The cervix in the cow is normally

very small. A very greatly dilated os uteri in the mare is more likely to interfere with retention of the semen and conception This is probably an indication of debility, and it has been corrected by good feeding and a course of tonics.

It is now coming to be widely accepted that the most common factor in preventing conception or in preventing retention of the ovum for development is metritis, and the degree or extent of metritis has been classified in various ways from a slight uterine catarrh to pyometra, according to the amount of purulent or catarrhal exudate present, and the changes which have occurred in the uterus. In the cow metritis not uncommonly follows upon retention of the fœtal membranes, but there is a probability, at least in some instances, that the stallion or bull, as the case may be, may infect the mare or cow during service.

In the barren mare the examination should be made some

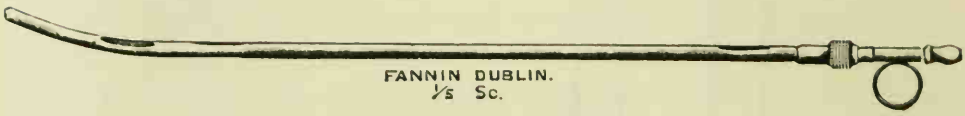

Fig. 30.—Double-way Uterine Catheter.

months before the breeding season commences in order to afford sufficient time for the correction of any defect which may be found. In any suspicious case of uterine catarrh or metritis it is advisable to insert a sterile swab into the os with all precautions against contamination, and cultivate from it any organisms which may be responsible for the disease. In this way an autogenous vaccine may be prepared and used in the treatment. In addition the uterus should be periodically washed out by means of a double-way metal catheter, first with sterile normal saline to remove the uterine discharge, and then injected with an efficient antiseptic solution which is not highly irritant or damaging to the mucous membrane, such as 0·1 to 0·5 per cent. watery solution of iodine, proflavine or acriflavine in water 1 to 3,000, mercurochrome ½ to 1 per cent. aqueous solution, argyrol 5 to 20 per cent. aqueous solution. These antiseptic injections should be given every few days until the discharge has ceased. Afterwards the freedom from uterine infection may be tested by bacteriological examination of uterine swabs.

In the cow vaccines may be prepared and used as in the mare. Uterine injections are not so readily administered on account of the very small calibre of the cervical canal. This necessitates the use of a fine copper catheter such as recommended by Nielsen. During the manipulations required for giving the injections all instruments used must be sterile and must be sterilized after each single case. The treatment consists in drawing back the cervix with forceps, introducing the catheter, removing the discharge if in considerable quantity, and injecting an antiseptic solution. The passage of the catheter takes some manipulation. Occasionally the cervical canal requires dilating, or the manipulation may be deferred

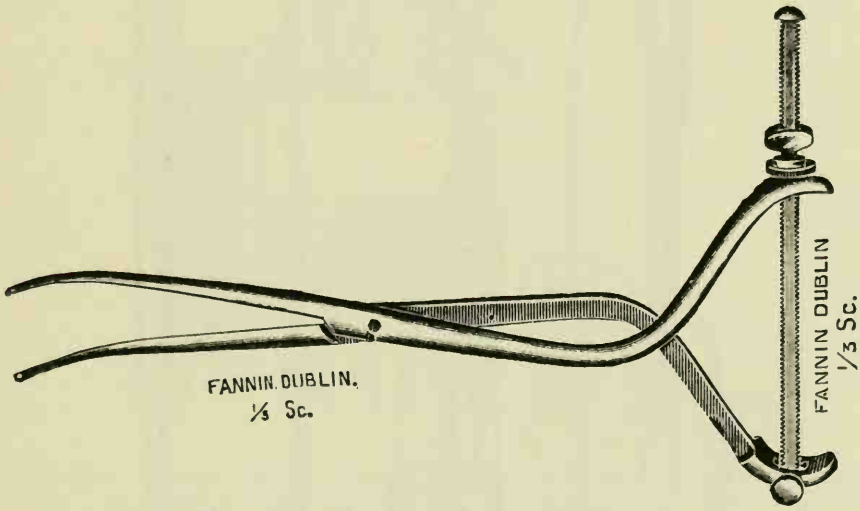

FIG. 31.—UTERINE DILATOR (COW).

until œstrus appears. A double-way catheter may be used for washing out any discharge with normal saline, but it can only be inserted into the body, whereas the small copper catheter can be manipulated, with care, far forwards into each horn, and guided by a hand in the rectum. The antiseptic injection may be left in the uterus and the uterine walls massaged through the rectum. Iodine solutions are much favoured in treatment, the strength used varying from 1 in 1,000 watery solution in mild uterine catarrh, when 300 to 400 c.c. is injected into each horn, to 5 per cent. tincture of iodine in quantity of 50 c.c. in pyometra. The treatment is repeated at intervals of two or three weeks. In the mild cases only one injection may be necessary, while in the severe cases treatment may require to be prolonged.

On the Continent herd treatment is adopted. All the breeding cows in a herd are examined periodically for pregnancy and all barren cows detected and treated according to indications. This is apparently an economic procedure, and

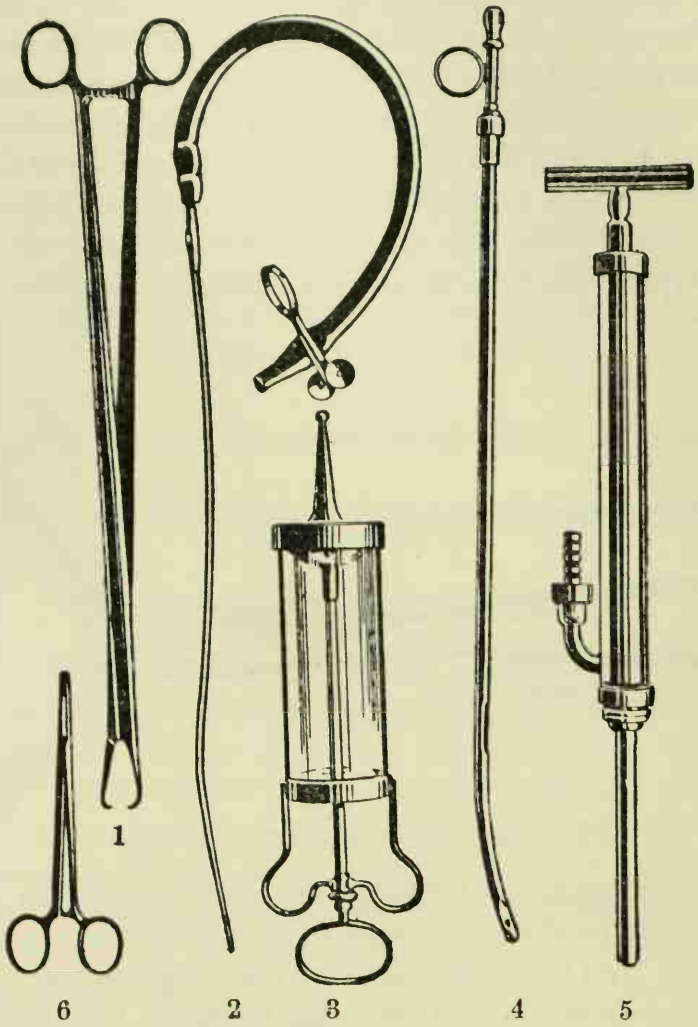

FIG. 32.—INSTRUMENTS USED BY NIELSEN IN THE TREATMENT OF METRITIS IN THE COW.

1, Uterine forceps; 2, fine metal uterine catheter; 3, syringe; 4, double-way catheter; 5, pump for use with the latter; 6, dressing forceps.

at least it ensures that incurable cases will be disposed of early, and that temporary barrenness will more quickly recover and the animal become pregnant. It is essential in dairy herds that lactation shall be maintained regularly, and for this each cow will have a calf every year. It might be advised that

every cow which does not conceive after the second or third service at separate periods should receive expert attention.

Much might be done to prevent uterine infections. During parturition in any handling required every attention should be given to surgical cleanliness. In retention of the fœtal membranes after parturition the appropriate treatment should be applied for their removal and the disinfection of the uterus. The breeding animal should be kept under the best hygienic conditions, and especially with a view to cleanliness, and should be pastured as long as possible. Prior to service the sheath and penis of the sire should be washed with an anti-

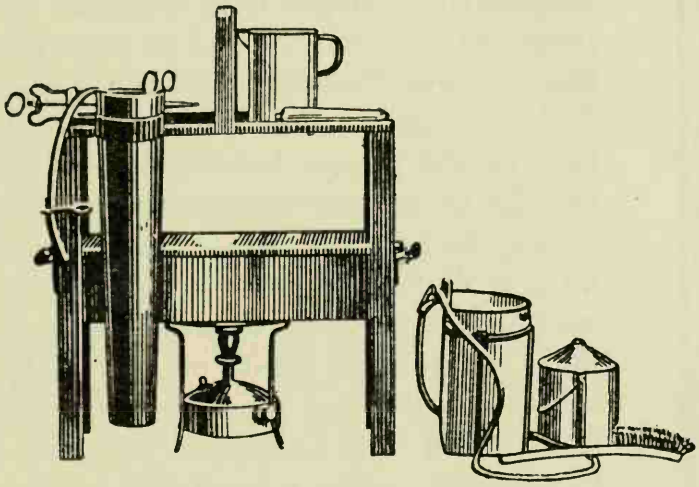

FIG. 33.—APPARATUS USED BY NIELSEN FOR STERILIZING INSTRUMENTS, TOGETHER WITH CONTAINERS FOR ANTISEPTIC SOLUTIONS.

septic. At times contagious abortion in cattle is associated with widespread sterility in a herd. This is not always the case. Probably in a large proportion of such cases the condition is due to secondary infection of the uterus by some accidental organisms.

Artificial insemination is often practised in the mare. In some cases it is useful to overcome some obstacle to successful fecundation. It is of service where the os uteri is unusually contracted, or is displaced, or the vagina ballooned, or very small or ruptured, or there is inability to retain semen in the vagina. Insemination consists in the artificial introduction of the semen of the sire into the uterus of the mare for the purpose of impregnating her. It is usually carried out in conjunction with copulation, and always when the female is in a

state of œstrus. The semen is collected from the vagina after coitus, and may be used only for the mare which has been served or for several mares according to the quantity of seminal fluid obtained. All that one needs is a convenient syringe (Fig. 34) with which to collect and transmit the semen, together with a sterilized vessel containing water at a temperature of 100° F., in which to warm and keep the syringe until the completion of coitus; then, having quickly emptied away the water and dried the vessel, it can be used to collect any semen that may be dropped from the mare or from the penis of the horse. Except in those cases where the semen or the majority of it has passed direct into the uterus, it will be found at the lowest part of the vagina behind the os uteri. The syringe being now introduced and loaded with semen, its nozzle is passed into the os, and the fluid is discharged into the uterus. A vaginal speculum may be used to facilitate the operation; cleanliness must, of course, be strictly observed. If more than one mare has to be inseminated from a single service, it is advisable to select for mating a mare with a roomy vagina, falling well below the level of the os, and to test vaginal secretions and examine the vagina with the aid of a speculum to make sure that the organ is free from catarrhal affections. Semen to retain its vitality must be kept at a temperature of 100° F., protected from cold winds and sunlight. This operation may also be used to husband the services of the sire. It has been tried with success not only in the mare, but also, to a lesser extent, in the cow and bitch. The editor has successfully inseminated cows with the semen of a bull which was unable to protrude the penis from the sheath.

FIG. 34.—INSEMINATOR.

Changes in the Ovum.

Before the ovum is ready for fertilization, its nucleus undergoes division on two successive occasions. On each occasion

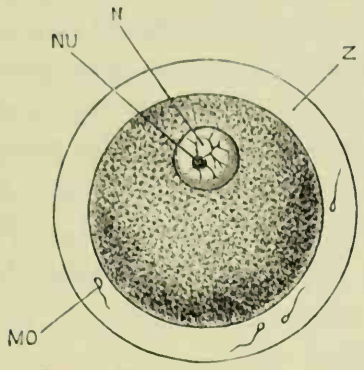

FIG. 35.—FULLY-FORMED OVUM SHORTLY BEFORE ITS DISCHARGE FROM THE OVARY. (FROM MARSHALL'S "EMBRYOLOGY.")

Z, Zona pellucida; MO, spermatozoon; N, nucleus or germinal vesicle; NU, nucleolus or germinal spot.

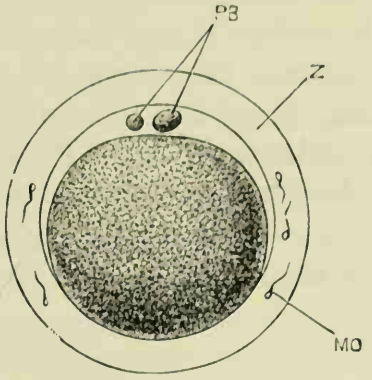

FIG. 36.—OVUM FROM OVIDUCT OF RABBIT, PENETRATED BY SPERMATOZOA IN ITS VITELLINE LAYER. (FROM MARSHALL'S "EMBRYOLOGY.")

PB, Polar bodies; Z, zona pellucida; MO, spermatozoon.

one of the products of division is extruded into the space under the zona pellucida as the first and second polar body respectively. Probably this occurs within the ovary, and is necessary

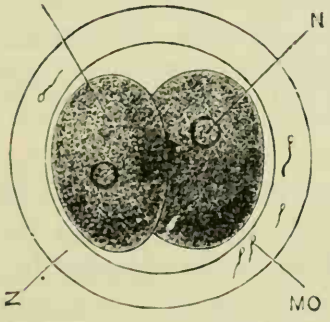

FIG. 37.—AN OVUM MORE ADVANCED IN THE OVIDUCT. (FROM MARSHALL'S "EMBRYOLOGY.")

Z, Zona pellucida; CB, segmentation cell; MO, spermatozoon; N, nucleus.

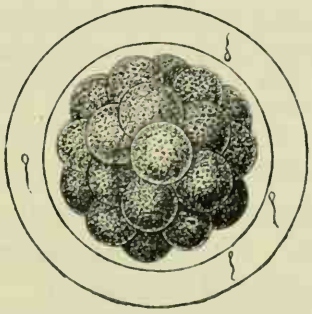

FIG. 38.—OVUM FROM LOWER PORTION OF OVIDUCT, SHOWING THE MORULA STAGE. (FROM MARSHALL'S "EMBRYOLOGY.")

to render tne ovum receptive of certain male characters at the time of fertilization, and also to prevent parthenogenesis. In the nuclei of both the ovum and spermatozoon the chromosomes

have been reduced by half during maturation and prior to fertilization.

Of the many thousands of spermatozoa which enter the genital passage at the time of copulation, only one is required to fecundate the ovum. It is no doubt the strongest or most fortunate. It pierces the zona pellucida, enters the protoplasm, loses its tail, and the head of the spermatozoon, the male pronucleus, fuses with the nucleus of the ovum, the female pronucleus. A single nucleus results from the fusion. This is the starting-point of development. The exact time of fecundation cannot be definitely stated, but

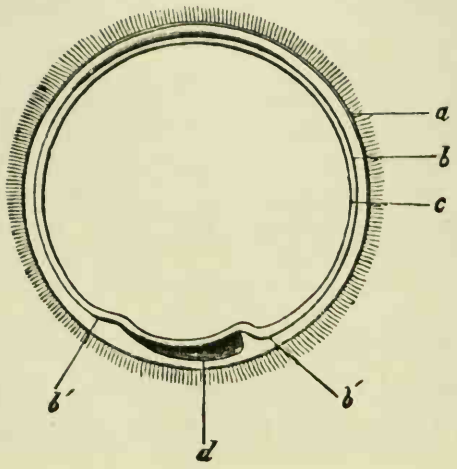

FIG. 39.—BLASTODERM AND PRIMITIVE TRACE. (SAINT-CYR.)

a, Vitelline membrane, with its commencing villosities; *b*, external (or serous) layer of the blastoderm; *c*, internal (or mucous) layer; *d*, body of the embryo; *b'*, *b'*, earliest cephalic and caudal elevation of the external layer.

must occur within a few days after copulation. After being fertilized, the ovum undergoes division in its passage to the uterus. The segmentation is complete or holoblastic in the domesticated mammals. The early stages of the development of the mammal have been made out chiefly from the rabbit and guinea-pig, and it is considered that in the other animals the same process occurs and in a similar time.

The segmentation in these animals begins about ten to twelve hours after fertilization, and continues during the next two days. The ovum first divides into two cells of slightly unequal size. Each of these cells again divides into two, and subdivides into four, eight, sixteen cells, etc. From

the larger of the two daughter cells a group is formed of which the individuals are larger than those formed from the smaller. These latter divide the more rapidly, and become arranged as a single layer round the larger cells, for which they form a sort of cap.

A solid mulberry-like mass of cells is so formed, the *morula*, and when complete has entered the uterus, on the fourth or fifth day, covered by the zona pellucida, surrounded with a layer of albumin which has become adherent to it during its passage from the ovary. It travels along the uterus until the ninth day. Then the ova arrange themselves, in multiparous animals, at regular distances apart within the horns of the uterus, where they proceed with their development. During its course, the outer layer of cells in the morula continue to increase rapidly in number; a cavity is formed, which is filled with a clear limpid fluid, and the cluster of larger cells become attached to the outer layer at one spot. This body, the blastodermic vesicle, is at first spherical in shape, but gradually increases in size, and becomes ellipsoidal. The zona pellucida becomes greatly reduced in thickness from stretching. On the ninth day the zona pellucida ruptures, and the outer cellular layer of the blastodermic vesicle comes into contact with the wall of the uterus. The cluster of inner cells become flattened out to form a single layer, and at this spot is seen the first evidence of the embryonal area, in the form of a pyriform patch. The superficial layer of cells form the epiblast, the inner layer the hypoblast. In its posterior part a third layer of cells, the mesoblast, is formed, probably from hypoblast and epiblast, and causes a thickening, known as the primitive streak. From these three layers the various tissues and organs of the fœtus are formed.

From the *epiblast* are formed—the epidermis and its appendages; the epithelium of the mouth, and of the salivary and other glands which open into the mouth; the enamel of the teeth; epithelium of the nasal passages; the crystalline lens; the retina; the epithelium lining the central canal of the spinal cord and ventricles of the brain; the tissues of the nervous system; the pituitary body; the pineal gland.

From the *mesoblast* are formed—the connective tissues; the blood and lymph corpuscles; the endothelium lining the heart, vessels, and serous membranes; the epithelium of the uriniferous tubules; the epithelium of the internal generative organs, and the generative products of both sexes;

the muscular tissues, voluntary, involuntary, and cardiac; the spleen and lymphatic glands.

From the *hypoblast* are formed—the epithelium of the alimentary tract from mouth to anus; the epithelium of the larynx, trachea, and lungs; the epithelium of the thyroid body, and of the Eustachian tube and tympanum; the epithelium of the urinary bladder, ureters, urethra, and allantois.

The hypoblast grows along and nearly lines the whole of the inner surface of the epiblast. Along the primitive streak, a longitudinal groove, the medullary groove, appears in the epiblast. This groove is later converted into a canal, the beginning of the cerebro-spinal system. Beneath this groove a longitudinal column of cells has been developed from the hypoblast. This is the notochord, or chorda dorsalis, the axis of the future embryo. Around it the vertebral column is formed. The mesoblast, growing rapidly, is divided into quadrangular masses, or somites, which give rise to portions of the vertebræ and to the muscles of the trunk. By means of infolding of the blastoderm, beginning first at the tail end and proceeding forwards, the embryo or embryonal area is marked off by constriction from the rest of the blastodermic vesicle, which then constitutes the yolk-sac or umbilical vesicle. This vesicle soon disappears in most mammals, but in the dog persists till birth. The cerebro-spinal canal becomes enlarged in front, and forms five vesicles from which the various portions of the brain are formed. The retina of the eyeball is developed as an outgrowth from the brain; the organs of smell and hearing soon become innervated from the same source. About the ninth day, or later, a cleft is formed in the mesoblast, which becomes the cœlom, or body cavity. The outer layer of mesoblast forms with the epiblast the somatopleure; the inner layer of mesoblast, together with the hypoblast, is known as the splanchnopleure. About the thirteenth or fourteenth day, in the sheep, folds or ridges grow out from the somatopleure over the embryo, first from the posterior extremity, later the sides, and last of all from the anterior extremity. These folds fuse to form the true amnion. By this fusion the embryo is provided with a dorsal covering of two layers, the inner the amnion, and the outer the false amnion, or primitive chorion, this being really the outer layer of the blastodermic vesicle. Into the cavity formed between these two layers the allantois

grows. This latter blends with the false amnion to form the permanent chorion. The embryo curves upon itself and encloses a portion of the splanchnopleure, separating off the intestinal furrow from the umbilical vesicle, with which it remains connected by the vitelline duct. This separation is the beginning of the umbilical cord. The umbilical vesicle is filled with a granular fluid which is conveyed for the nutrition of the embryo; when this alimentary reserve is nearly expended, the allantois appears. This begins as a small enlargement, which the intestinal furrow (hind-gut) pushes towards the inferior portion of its body; the enlarge-

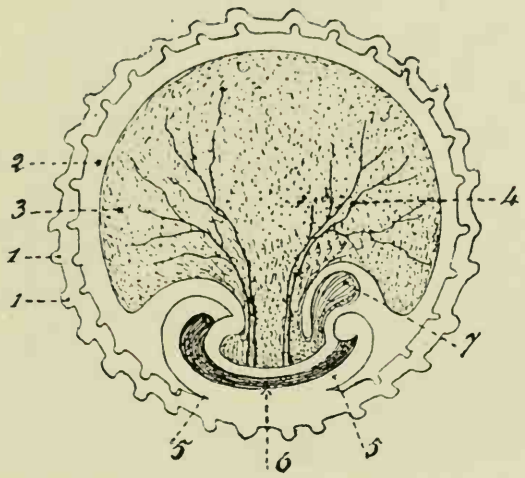

FIG. 40.—OVUM WITH DEVELOPING AMNION AND ALLANTOIS.

1, Vitelline membrane and its villosities; 2, external layer of blastoderm; 3, umbilical vesicle; 4, omphalo-mesenteric vessels; 5, 5, caudal and cephalic folds of developing amnion; 6, embryo; 7, allantois.

ment becomes elongated and vesicular-looking, and gradually increases in size by bringing the umbilical vessels towards its border. Becoming still more elongated, it passes through the umbilicus, and spreads itself over the inner face of the chorion, between the latter and the amnion. It is divided into two sacs by a constriction, the urachus, at the umbilical cord; the inner sac is the smallest, and forms the bladder; while the external, the most voluminous, composes the proper allantois.

In the sheep, on the ninth day the blastoderm lies in contact with the uterine mucous membrane. On the twelfth day the vesicle lies in the lower portion of the uterine

cornu, and gradually grows out into both horns of the uterus. If two embryos are present, they confine themselves, one to each horn. Up to the twentieth day the embryo receives its nourishment only from the uterine glands and the umbilical vesicle. After this villi develop on the outer covering of the embryo, and by the twenty-eighth day have become fitted into the little depressions on the maternal cotyledons. The placenta is finally established about the seventy-eighth day.

In the horse, up to about the fifth week the embryo is united to the uterine wall by a small area of the outer

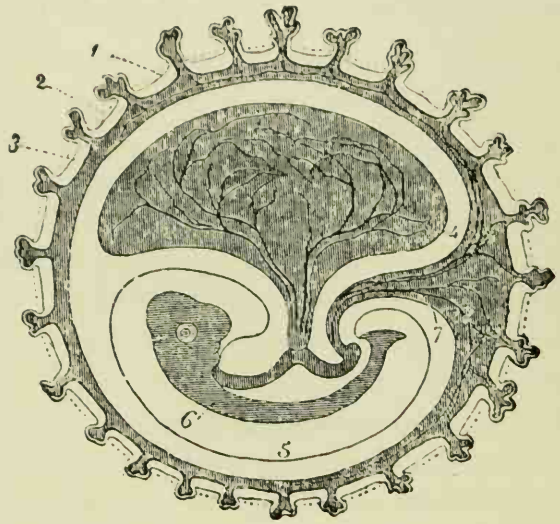

FIG. 41. — OVUM ABOUT A MONTH OLD. (SAINT-CYR.)

1 Vitelline membrane, which has almost disappeared; 2, external layer of the blastoderm; 3, allantois penetrating the villosities; 4, umbilical vesicle; 5, union of the caudal and cephalic processes, and formation of the cavity of the amnion; 6, embryo; 7, allantois.

layer of blastoderm over the umbilical vesicle. This area of attachment increases in size, and another line of union about ¼ inch wide forms around the equator of the embryo. About the sixth week the latter girdle becomes changed to near the pole. About the eighth week the yolk-sac has been exhausted of its contents, the attachment is reduced, and then the allantois is developed and the girdle of union becomes folded into ridges which fit into grooves in the uterine mucous membrane. The outer covering of the embryo now forms little villi, derived from the allantoic sac, which are accommodated in pits in the uterine wall.

Ewart has shown that because of these changes detachment

of the embryo is liable to occur at the third, sixth, and ninth week, and the mare break service.

Appendages of the Fœtus.

These appendages comprise the chorion, the amnion, the allantois, the umbilical vesicle, the placenta, and the umbilical cord. In none of these appendages have nerves been found.

The **Chorion**, the outer envelope proper to the embryo, is found covering it loosely at the earliest period of its existence.

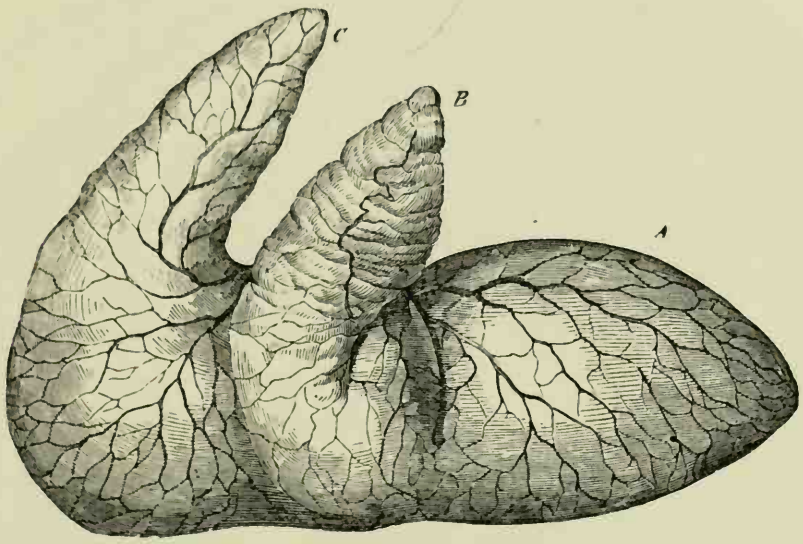

FIG. 42.—CHORION OF THE MARE AT MID-TERM: INFLATED. (COLIN.)

A, Posterior portion occupying the body of the uterus; B, left cornu plicated and sacculated; C, right cornu, longer than the left, and containing a portion of the fœtus.

It is a vast membranous sac, completely closed, and which, being moulded upon the uterine cavity, resembles the uterus in form, having a body and two cornua; the latter, however, are not co-extensive with those of the uterus. When the chorion is distended, its cornua show fine and deep plicæ, or bulgings, like the cæcum; the cornua are always unequal in size, that in which the fœtus is developed being of course the larger.

The external surface, otherwise smooth, is studded with innumerable small, red, short papillæ, or processes, which are formed by the placental villous tufts. This papillary face adheres slightly to the internal face of the uterus. The

inner surface is lined by the external layer of the allantois, to which it is closely adherent, except at the insertion of the vascular cord, where there exists a kind of conical infundibulum occupied by the umbilical vesicle. On this surface the umbilical veins and arteries ramify, their minute divisions traversing

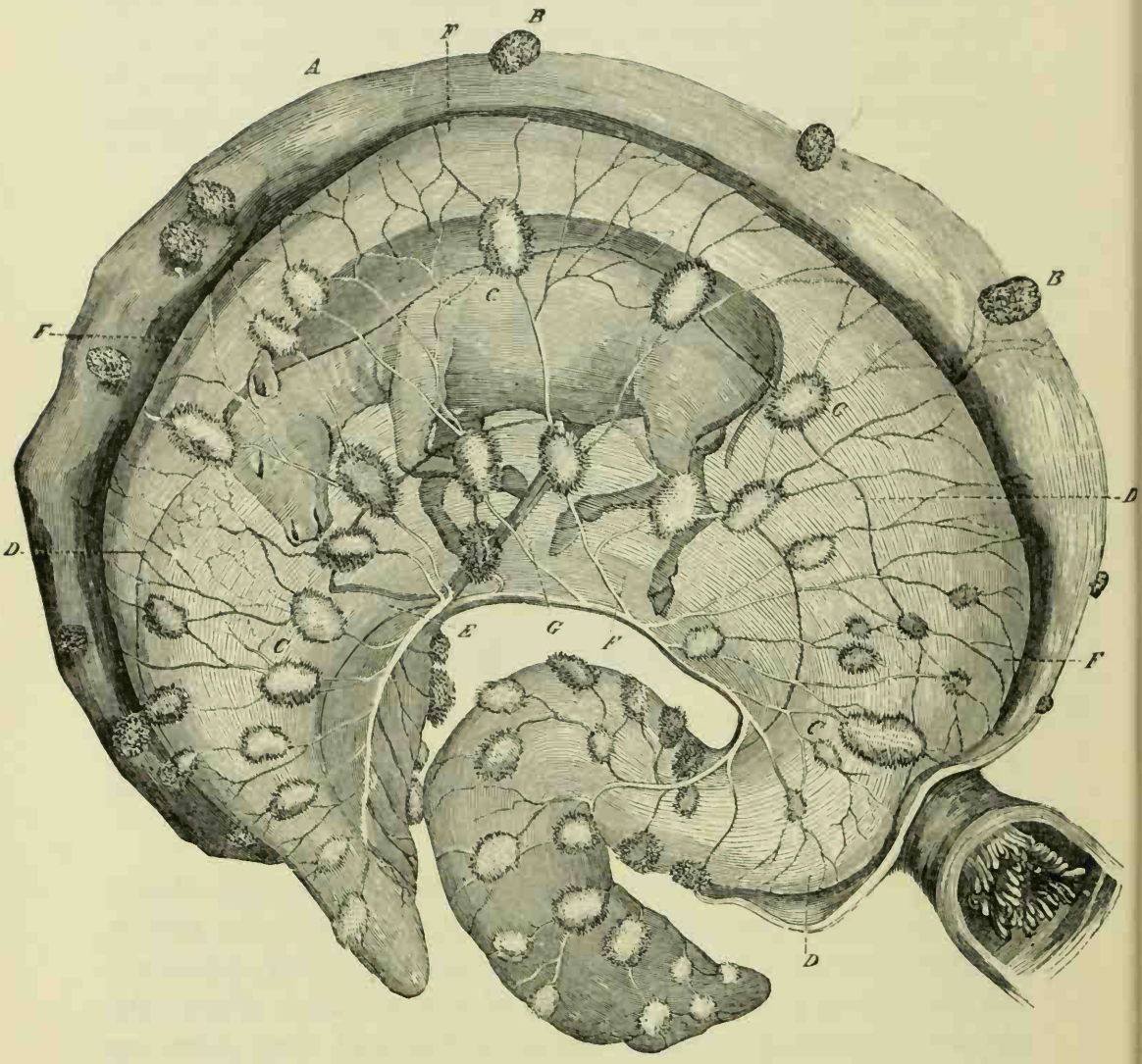

FIG. 43.—FŒTAL MEMBRANES OF THE COW AT MID-TERM. (COLIN.)
A, Uterus opened on its left side; B, B, cotyledons of the uterus; C, C, placentulæ; D, D, allantois; E, vesicle of the urachus; F, amnion; G, umbilical cord.

the membrane to form the placental villosities. The chorion itself is devoid of vessels until the allantois is developed.

In *ruminants* the chorion over the middle of its inner surface is united to the amnion, and the allantois by loose

gelatinous connective tissue, so laminated that it might be mistaken for different layers of membrane. It is only covered by the allantois in the portions corresponding to the cornua which are longer than those of the uterus. It offers numerous small red masses (the placentulæ), studded

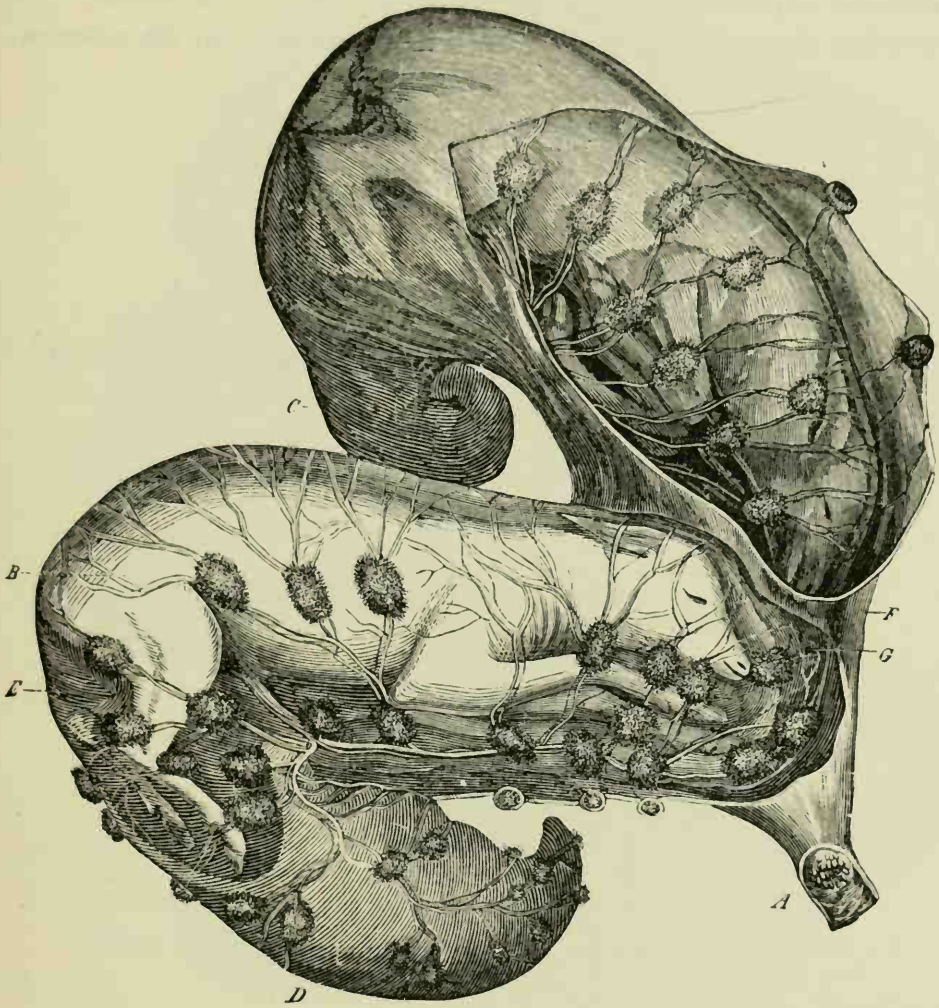

FIG. 44.—FŒTAL MEMBRANES OF THE GOAT AT FULL TIME: TWINS. (COLIN.)

A, Cervix of the uterus; B, left cornu; C, right cornu; D, allantois of one of the fœtuses; E, amnion of ditto; F, portion of the uterine wall left at the middle of its body, where the fœtuses come in contact; G, union of the two chorions at the cervix uteri.

at various distances from each other on the surface next the uterus, and which effect a very important connection between the latter and the chorion. The chorion extends to the extremities of both horns and, in the early stages, may be

mistaken for a long thin string of mucus, the central portion only being distended with fluid.

In the *sheep* and *goat*, when there are two fœtuses, the cornua of the chorion are joined so as to look externally like one sac.

In the *pig* the chorion has the form of an elongated sac without cornua, which is much longer than the fœtus. Its internal face is similar to that of ruminants; on its external

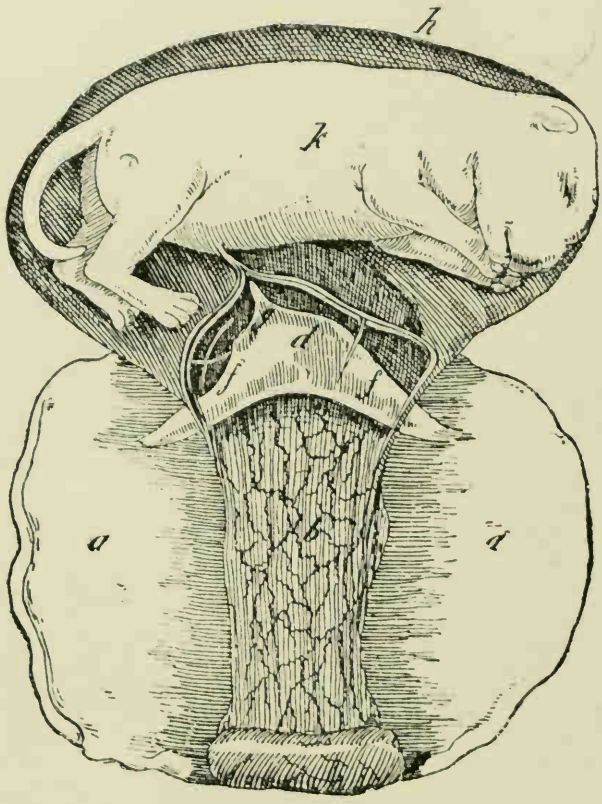

Fig. 45.—Fœtus of Bitch and its Envelopes.

a, Chorion; *b*, placenta; *d*, *ff*, umbilical vesicle and its cornua; *h*, amnion; *k*, fœtus.

face are groups of numerous small papillæ, so that placentation in this animal is disseminated. Here and there are bare spots, and there are no papillæ at its extremities.

In the *bitch* and *cat* the chorion is similar to that of the pig. Its inner face is everywhere in contact with the allantois, though it does not adhere closely to it.

The **Amnion** is the second complete sac enveloping the fœtus. It floats freely in the chorial sac, to which it is only attached at a single point, through the medium of the

umbilical cord. It immediately covers the fœtus, with the integument of which it is continuous through the umbilical cord. In the later stages it is distended with fluid, and so separated from the fœtus. In shape it is spherical or ovoid,

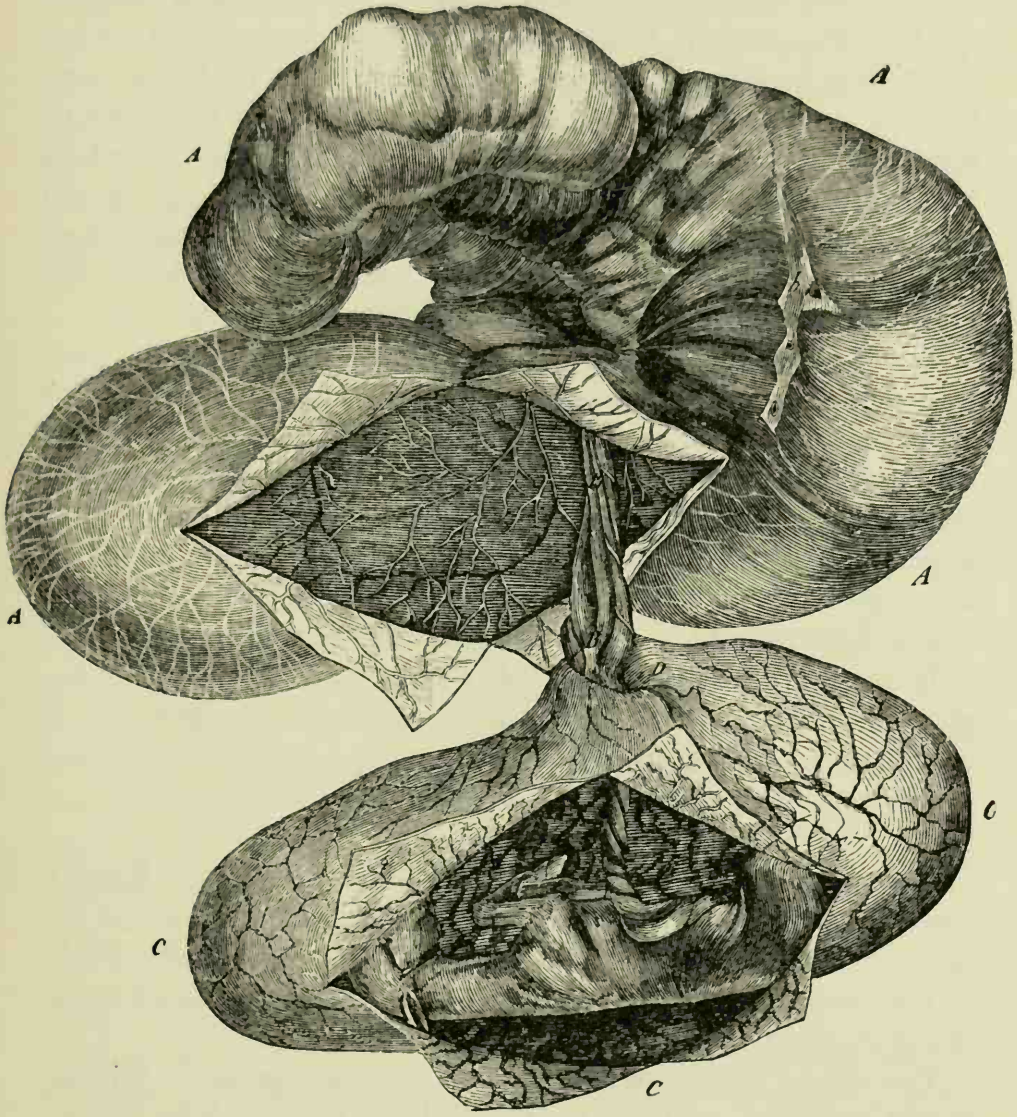

FIG. 46.—FŒTUS OF MARE AND ITS ENVELOPES. (CHAUVEAU.)

A, Chorial sac; C, amniotic sac withdrawn from the allantoid cavity, and opened to expose the fœtus; D, infundibulum of the urachus; B, allantoid portion of the umbilical cord; *b*, portion of the external surface of the chorion destitute of placental villosities, and corresponding to the point of insertion of three pediculated hippomanes.

and has thin transparent walls, which are firm and more resistant than the other membranes. Small opaque masses

are scattered over it. These masses are much more numerous and larger in the cow than in the other animals. The external face is covered by the inner layer of the allantois, to which it slightly adheres. The internal face is quite smooth. It secretes a fluid—the liquor amnii—which bathes the fœtus and distends the amniotic cavity. It does not exhibit either vessels or nerves when in a healthy condition. Just beside the umbilical cord a small membranous pouch is formed between the amnion and allantois, in which the umbilical vesicle terminates. Towards the termination of gestation, one of the extremities of the pouch, corresponding to the posterior limbs of the fœtus, is stretched into a very short wide horn. In the bitch the amnion and allantois are closely adherent throughout.

The *Liquor Amnii* is an albuminous, alkaline fluid contained in the amniotic sac, in which the fœtus is suspended as in a hydrostatic bed. It is abundant and limpid at an early stage, and becomes scantier, viscid, and citron or red-coloured, at an advanced stage, when it is adhesive and agglutinates the hair. Generally it is most abundant at the middle of gestation. It varies from 5 to 6 litres in the cow and mare, and in the sheep from 100 to 500 grammes.

It contains 99 per cent. of water, as well as albumin, glucose, creatin, urea, and other elements of urine, and often, especially in the foal, fragments of meconium from the intestines of the fœtus. The urine is discharged into the cavity from the fœtal urethra.

Probably the formation of the mucous layer that invests the young animal at birth is due to the precipitation on its skin of the mucus and yellow matter contained in this fluid. It also contains portions of the thick epidermis cast off from the plantar surface of the hoof of solipeds.

The liquor amnii preserves an equable temperature for the young creature, protects it from injury, from sudden movements and shocks or uterine contractions, favours its movements and development, and protects the mother from injury by the fœtus towards the termination of gestation. During parturition it protrudes the membranes, is the primary agent in dilating the os, and, by lubricating the vagina, facilitates the passage of the fœtus.

The **Allantois** arises as a protrusion of the hind-gut just

behind the yolk-sac. It leaves the embryo in the region which afterwards becomes the umbilicus. The portion of the diverticulum of the hind-gut inside the umbilicus afterwards forms the urinary bladder. The allantois carries the umbilical vessels from the umbilicus to the chorion. It is very thin and pellucid, and is slightly fibrous in structure. It lines the inner face of the chorion, and is reflected around the point of insertion of the umbilical cord, to be spread over the outer surface of the amnion, being arranged to some extent like a serous membrane. The allantois is more firmly attached to the chorion than the amnion. The cavity

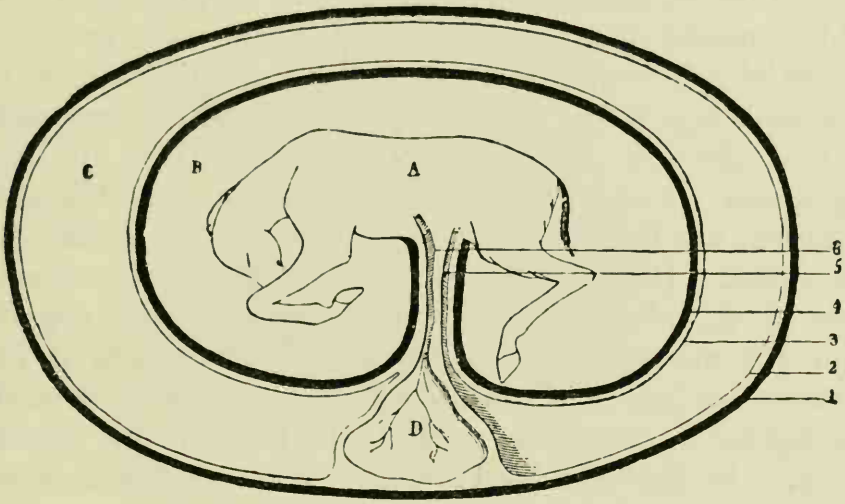

FIG. 47.—PLAN OF FŒTAL ENVELOPES IN MARE. (SAINT-CYR.)

A, Fœtus; B, cavity of the amnion: C, cavity of the allantois; D, umbilical vesicle; 1, chorion; 2, chorial layer of the allantois; 3, amniotic layer of the allantois; 4, amnion; 5, urachus, the expansion of which forms the allantois; 6, pedicle of the umbilical vesicle.

of the allantoic sac is in communication with the interior of the bladder by means of the urachus—a narrow canal in the amniotic portion of the umbilical cord. This canal widens at the origin of the allantoic portion, where its walls are continuous with the allantois and forms a sheath for the cord. The allantois in the *mare* completely envelops the amnion. In *ruminants* and *swine* it forms only a partial covering, especially where it receives the urachus. In multiparous animals the allantois of each fœtus is always separate. In the *bitch* and *cat* the allantois is similar to that of solipeds, but is less closely connected with the chorion, except over the placenta.

The allantoic cavity contains a fluid—the *Allantoic Liquid*—which is greatest in amount at an early period. It is at first colourless or slightly turbid, but later becomes yellowish in colour. It is similar in its properties to the liquor amnii, and contains water, albumin, osmazone (a nitrogenous, mucilaginous material insoluble in alcohol), urate of urea, lactic acid, phosphates of soda, lime, and magnesia, and traces of sugar. In the later stages of gestation, the renal excretion of the young animal passes from the bladder along the urachus, and deposits near the allantoic orifice of that tube a thick fluid of a reddish colour and urinous odour, containing erythrin and hippuric acid. The fluid contains also one or more small oval or discoid masses of a brownish colour, from the size of a pea to that of a hen's egg, either floating about in the cavity or attached to the allantois by a narrow pedicle. They are called *hippomanes*. Usually they have the consistency and elasticity of gluten, are flattened, and are thinner at the border than the centre. It is not improbable that they are inspissated parts of the allantoic fluid which were originally deposited upon the membrane. They contain much oxalate of lime. In *ruminants* laminated deposits like hippomanes, but smaller and lighter in colour, are occasionally found in the allantoic cavity. In the *sow* small white spherical bodies appear between the chorion and allantois.

The **Umbilical Vesicle, Yolk-Sac, Saccus Intestinalis,** or **Vesicula Alba,** is a small fusiform pouch lodged in an infundibulum at the extremity of the umbilical cord. Its fundus adheres to the chorion, while its opposite end is prolonged into the cord, and even communicates with the terminal portion of the small intestines. Its origin has already been noted (*v.* p. 79). Its walls receive a special vessel from the anterior mesenteric artery, and a special vein leaves it for the vena portæ (the omphalo-mesenteric vessels). It supplies nourishment to the fœtus before the development of the placenta. It is a transitory organ, and near parturition it is more or less atrophied, being represented by a small reddish-brown cord. In *ruminants* and the *pig* it is longer than in the *mare*, and disappears about the second or third month. In the *bitch* and cat it is transversely elongated, extending into pointed cornua, and persists up to the end of gestation.

The **Placenta** varies extremely in different species.

In *solipeds* it is constituted by a multitude of short villosities or filiform papillæ, which are spread in a uniform manner over the external surface of the chorion (diffuse placenta), a bare patch being noted only at a few points, such as the os uteri. These villi are received into corresponding depressions, or follicles, in the lining membrane of the uterus. These are very red in colour, slender, and easily torn. They contain loops of small bloodvessels, the terminal ramifications of the

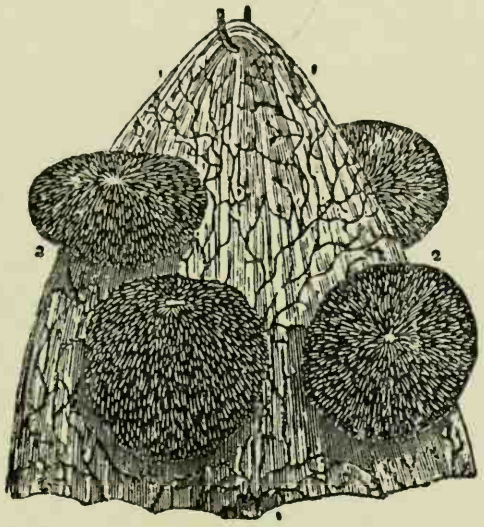

FIG. 48.—PORTION OF CHORION WITH PLACENTULÆ: COW. (GURLT.)
1, Chorion ; 2, placentulæ.

umbilical vessels. These villosities bring the capillary systems of mother and fœtus into the closest relationship, the very thin coats of the vessels chiefly intervening between the two circulations. There is no continuity between the maternal and fœtal circulations, all the important changes taking place through the walls of the capillaries. The function of the placenta is to act as a nutrient and respiratory apparatus during a portion of intra-uterine existence. When gestation is terminated, the placenta becomes remarkably rigid, the vessels are obliterated and transformed into fibrous tissue, and the external face of the chorion is wrinkled and withered-looking.

In the *cow* the villi of the chorion are developed and agglomerated in large numbers at certain points of its surface,

to constitute a multiple polycotyledonary or tufted placenta, which is composed in this way of from sixty to eighty placentulæ, or fœtal cotyledons. They are bright-red, oval, concave patches, and correspond with the maternal cotyledons of the uterus, already described, into which they are received. During pregnancy the number of maternal cotyledons is increased (Chauveau and Colin). Sometimes in the gravid uterus, and often near the os, numerous accessory caruncles, accessory cotyledons, have been found on the mucous membrane, grouped close together and in an irregular manner between the rows of permanent cotyledons. The largest

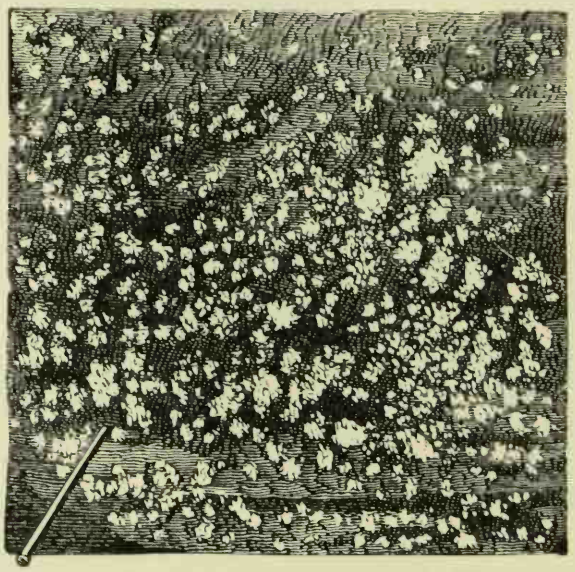

FIG. 49.—ACCESSORY PLACENTULÆ IN A COW'S UTERUS. (FRANCK.)
They appear like innumerable miniature cauliflowers growing from the surface of the mucous membrane.

is not as big as a walnut, and they often come into use towards the later stages of gestation, if required. When gestation has commenced, the surface of the maternal caruncles, previously smooth, becomes convex, and is covered with reticulate processes which border the crypts and give it a finely cribbled appearance. The largest are found in the body of the uterus, and they become smaller as they approach the extremity of the cornua. In shape they are not unlike mushrooms, and are dark yellow in colour. The fœtal cotyledons on their surface present a multitude of long, conical branched villi, measuring from $\frac{4}{10}$ to $\frac{6}{10}$ inch, which are received into the depressions of the maternal cotyledons.

Between the villi of the placenta and the mucous membrane of the uterus in all our animals there is always found a small quantity of thick, white, milky-looking fluid—the *Uterine Milk*—containing water, leucocytes, proteids, fats, glycogen, hæmoglobin derivatives, and salts, probably required for the nourishment of the fœtus, and formed in part by the secretion of

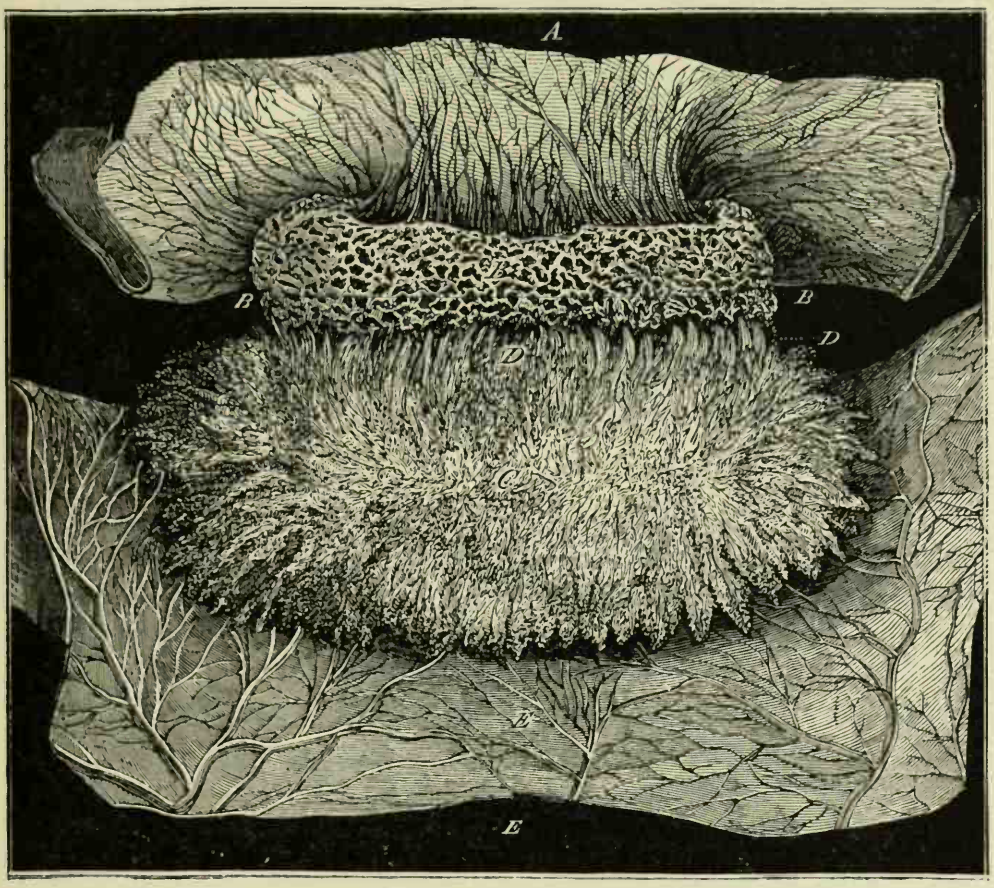

FIG. 50.—MATERNAL AND FŒTAL COTYLEDONS OF THE COW. (COLIN.)
A, Pedicle of the maternal cotyledon ; B, B, maternal cotyledon ; C, fœtal cotyledon ; D, placental villi ; E, chorion.

the uterine glands. This uterine milk is most abundant in ruminants.

In the *sheep* and *goat* the fœtal cotyledons are convex, not so wide as, but thicker than, in the cow, and the villi are more delicate.

In the *pig* the placenta is diffuse, though the tufts do not

form a continuous layer as in the mare, but are collected together in small but closely grouped clusters. The chorion is destitute of the papillæ at the extremities, and the white clusters of villi present a mottled appearance.

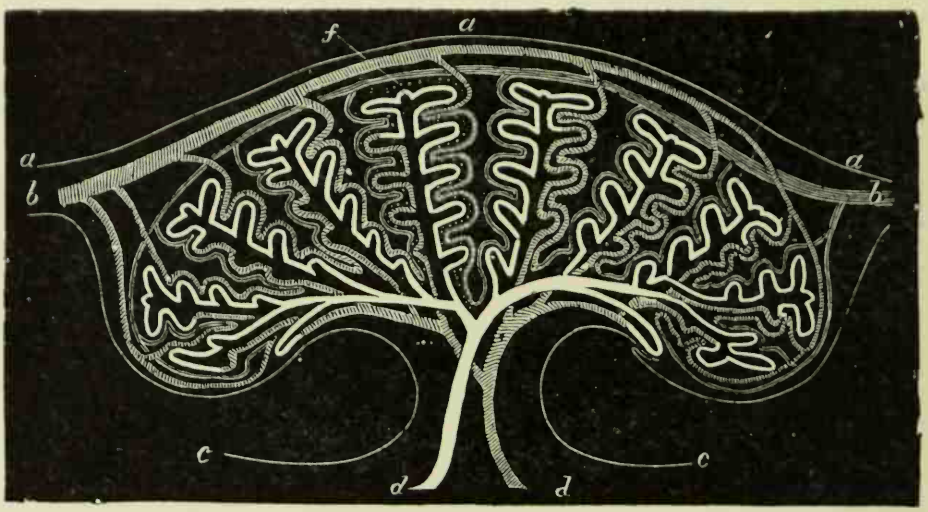

FIG. 51.—COTYLEDON OF A COW'S UTERUS. (PETTIGREW.)

aa, Surface of fœtal chorion; *b*, *b*, bloodvessels of fœtal chorion; *cc*, surface of uterine mucous membrane; *d*, *d*, bloodvessels of ditto; *f*, secretion from utricular glands—cotyledonous milk—between maternal and fœtal vessels, and which is necessary to the mutual interchange of gases, and nutrient, effete, and other matters, between parent and offspring.

In the *bitch* and *cat* the placenta forms a thick annular band or zone, about 1 or 1½ inches wide, passing round the middle of the chorion. It is therefore said to be "zonular." This zone is concave within, livid or dark brown during gestation, and limited by dark green borders. The green colour of the border is due to hæmorrhages which have occurred between the uterine surface and the epiblast (Duval). The villi are ramified and leaf-shaped, implanted in the uterine mucous follicles. In this type of placenta (placenta cumulata) the uterine epithelium is destroyed by certain cells on the outer side of the placenta, and the maternal blood is accommodated in spaces formed by these cells (trophoblasts). In the dog and cat, at birth the maternal mucosa is removed to some extent with the fœtal membranes, and a raw surface left (deciduate placenta), while in the other domesticated animals the uterine mucous membrane is left intact (adeciduate placenta).

The arrangement of the placenta in the various domesticated animals may be expressed in tabular form as follows:

Simple Placenta	Diffuse	Mare. Sow.
	Local and zonary	Bitch. Cat.
Multiple or Polycotyledonary Placenta	Concave Cotyledons	Cow.
	Convex Cotyledons	Ewe. Goat

As already mentioned, respiration in the fœtus is effected through the placenta, and the lungs are functionless. On that account the circulation of the fœtus, even at an advanced period, presents certain differences from that of the animal after birth. The blood is carried from the internal iliac arteries by the umbilical arteries to the placenta. From the placenta it returns by the umbilical vein to the fœtus. This vein passes forwards from the umbilicus along the abdominal floor of the fœtus to the liver and there joins the portal vein. In animals other than solipeds it is connected directly by a vein (the ductus venosus) with the posterior vena cava in front of the liver. In the horse tribe only, all the blood in the umbilical vein passes first through the portal capillaries before it reaches the posterior vena cava. By the latter vein the blood is carried to the right auricle. The greater part of this blood is directed through an opening (the foramen ovale) in the interauricular septum into the left auricle. The blood, which reaches the right ventricle, is discharged into the pulmonary artery, but a large proportion of it passes from that artery through the ductus arteriosus—a connecting vessel —into the posterior aorta. Only a small portion of blood passes to the lungs, sufficient to supply them with nourishment. From this condition of the fœtal circulation it follows that the umbilical vein only carries unmixed arterial blood. After birth the foramen ovale soon closes up, and the ductus venosus, ductus arteriosus, and umbilical vessel become converted into impervious cords.

The process of nutrition of the fœtus at the placenta, as

pointed out by Lesbre, takes place through (1) the endothelium of the maternal vessels; (2) the surrounding layer of connective tissue; (3) the uterine epithelium; (4) the epiblast of the fœtal villosity; (5) the mesoblastic tissue and the capillary endothelium of the fœtal villosity. These tissues exert a selective action upon the materials brought to the placenta in the maternal blood-stream. Certain medicinal substances

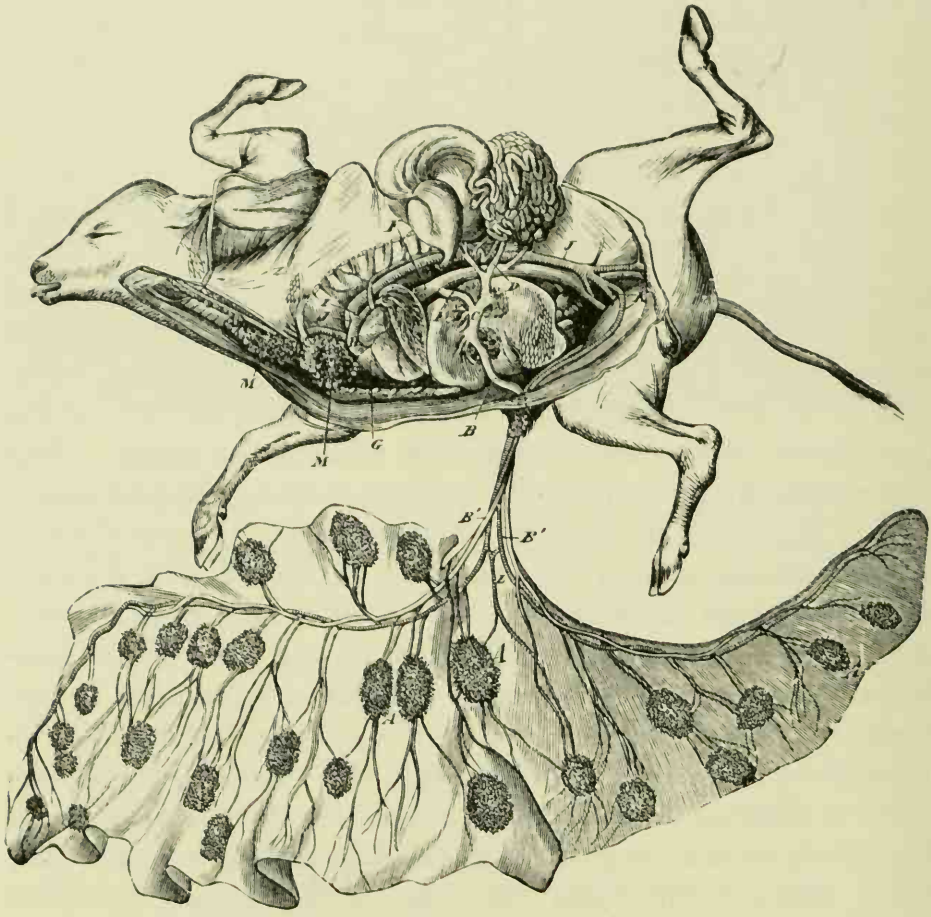

FIG. 52.—FŒTAL CIRCULATION: ADVANCED PERIOD. (COLIN.)

A, Placentulæ; B′, B′, umbilical veins, with their common trunk, B; D, vena portæ and its anastomosis, C; E, ductus venosus; F, posterior vena cava; G, right ventricle of heart; H, pulmonary artery; J, J, aorta; I, ductus arteriosus; K, umbilical arteries, with their anastomosis at the extremity of the umbilical cord.

may, however, pass from the maternal to the fœtal circulations, such as salicylic acid, potassium iodide, potassium chlorate, chloroform. Usually the placenta acts as an excellent filter, and prevents the passage of foreign bodies, such as bacteria, into the fœtal blood. Exceptionally their passage is per-

mitted, but chiefly as the result of capillary hæmorrhage, as in glanders, anthrax.

The **Umbilical Cord, Funis, or Navel String**, is a collection of vessels which form the means of communication between the fœtus and the fœtal membranes during its uterine existence, and which loses its functions at birth. It is visible at an early period of pregnancy. It is divided into two portions: An *amniotic*, the longest, always twisted on itself like a rope, and covered by the amnion, which passes along it to become continuous with the skin at the umbilicus; and an *allantoic* portion, much shorter, less twisted, and covered by the sheath that continues the two layers of the allantois, until it is inserted into the upper wall of the chorial sac, between the cornua. The groundwork of the cord consists of embryonic connective tissue, Wharton's jelly (Whartonian gelatine). The vessels embedded in it are the following: Two umbilical arteries, one umbilical vein, the urachus in the amniotic portion, and the remnants of the umbilical vesicle. The umbilical arteries, branches of the internal iliac artery or its internal pudic branch, leave the abdomen at the umbilicus, and descend in a spiral fashion in the cord. They give off small twigs to the amniotic sac, and terminate in a number of large placental branches. These branches start from the terminal extremity of the cord, pass in every direction between the chorion and the external layer of the allantois, where they may be seen to form a network by their anastomoses, and end in the capillaries of the placenta. From these capillaries the blood is withdrawn by veins which form an intricate network between the chorion and allantois. These veins pour the blood into two chief trunks, which join to form the umbilical vein. This vein ascends in the cord in company with the two corresponding arteries, and on reaching the umbilicus bends forward on the inner surface of the abdominal wall, where it is covered by peritoneum, and on gaining the liver enters that organ to open directly into the vena portæ. In other animals than solipeds it also communicates directly by a special vessel—the ductus venosus—with the posterior vena cava. The umbilical vein has no valve. The urachus is an irregularly bulging canal, connecting what is eventually the bladder with the allantoic cavity, and present only in the

amniotic portion of the cord. After birth it rapidly contracts, especially at the fundus of the bladder, until it is quite closed, and nothing is left but the fold of peritoneum that sustained it, the inferior ligament of the bladder. It sometimes happens with the foal, however, but more frequently with the calf, that it persists, the urine in this case escaping by the umbilicus. The umbilical vesicle, with its omphalo-mesenteric vessels, has already been referred to.

In *ruminants* and the *pig* the umbilical cord has no allantoic portion, and the umbilical veins are double until they reach the umbilicus, where they join.

In the *bitch* and *cat* the allantoic portion is very short, and the omphalo-mesenteric vessels are very large, and persist till the end of gestation.

In the early days of fœtal life the cord contains a portion of the intestines, but as the cavity of the abdomen is formed and closes, the viscus is retracted within it. Sometimes, however, this retraction is incomplete, and hernia of the intestines exists at birth, and even for some time after that event. With regard to the curious torsion of the cord, as many as twelve complete turns have been found in it at six months, but it is far from being constant. It has been accounted for by the movements of the fœtus and excessive growth of the umbilical arteries.

The *dimensions of the cord* vary with species and individuals. Compared with that of the human fœtus, it is short in solipeds and ruminants. In the mare, towards the end of gestation it is at least as long as the young animal is tall, and varies from $2\frac{1}{2}$ feet to 3 feet 4 inches, and $3\frac{1}{2}$ inches in circumference. In the cow it varies from 9 to 18 inches, and is only about one-quarter the length of the fœtus. If the mare is recumbent during parturition, the cord may not be ruptured till she rises. In the cow the fœtus is born free of its membranes, and the cord is broken before it reaches the ground. In the sheep the cord varies from $\frac{3}{4}$ inch to 2 inches at the time of parturition. In the pig it is comparatively very long, sometimes stretching the whole length of the fœtus. In the bitch and cat it is very short, and measures from 1 to 2 inches at birth, or about two-fifths of the length of the body.

At birth the umbilical cord is usually torn or gnawed through at a short distance from the umbilicus of the fœtus; the remaining portion dries up, dies, and falls off in a few days. The ruptured umbilical arteries retract within the abdomen, but the umbilical vein remains open for a time, and may serve as an avenue for infection, as in navel infection.

DEVELOPMENT OF FŒTUS.

Periods of Development.

From conception to maturity, utero-gestation may be divided into seven periods, or stages, as follows:

First Period.—Towards the second week after conception, the ovum or germ has passed from the ovary into the uterus; it is then about $\frac{1}{12}$ inch in diameter.

Second Period.—In the third and fourth weeks of gestation in the mare, ruminants, and pig, the third week in carnivora, there appear the first traces of fœtus, the head, body, and limbs being first distinguished. Towards the twenty-eighth day the embryo of the mare measures $\frac{1}{2}$ inch, that of the cow $\frac{1}{3}$ inch, that of the sheep at twenty-five days a little over $\frac{1}{3}$ inch, and the bitch at eighteen days about $\frac{1}{6}$ inch.

Third Period.—From the fifth to the eighth week in the mare and cow, the fifth to the seventh in the sheep and goat, the fourth to the sixth in the pig. The fœtus of the mare has acquired a length of rather more than 2 inches, that of the cow $1\frac{3}{4}$ inches, that of the sheep and goat $1\frac{1}{4}$ inches, that of the pig $1\frac{3}{4}$ inches, and that of the bitch about 1 inch. At the end of this period the first indications of the hoof, in the form of little colourless elevations, appear at the extremities of the limbs.

Fourth Period.—From the ninth to the thirteenth week in the mare, the ninth to the twelfth in the cow, the seventh to the ninth in the sheep and goat, the sixth to the eighth in the pig, the fifth in carnivora. The length of the fœtus of the mare is 6 inches, that of the cow $5\frac{1}{2}$ inches, that of small ruminants $3\frac{1}{2}$ inches, that of the pig 3 inches, and that of the bitch $2\frac{1}{2}$ inches. Towards the end of this period the four stomachs may be recognized in ruminants.

Fifth Period.—This extends from the fourteenth to the

twenty-second week in the mare, the thirteenth to the twentieth in the cow, the tenth to the thirteenth in the sheep and goat, the eighth to the tenth in the pig, and over the sixth week in carnivora. At this stage the fœtus in the mare is about 13 inches long, that of the cow 12 inches, that of the sheep and goat 6 inches, that of the pig 5 inches, and that of the bitch 3½ inches. In this period tactile hairs appear on the lips, upper eyelid, and orbital arch. Teats may be plainly seen in the female.

Sixth Period.—From the twenty-third to the thirty-fourth week in the mare, the twenty-first to the thirty-second in the cow, the thirteenth to the eighteenth in the sheep and goat, the eleventh to the fifteenth in the pig, the seventh to the eighth in carnivora. The fœtus of the mare and cow has acquired a length of more than 2 feet, that of the sheep more than 1 foot, that of the pig about 7 inches, and that of the bitch about 5 inches. The eyelashes are well developed, a few hairs appear on the tail, head, and extremities.

Seventh Period.—From the thirty-fifth to the forty-eighth week in the mare, the thirty-third to the fortieth in the cow, the nineteenth to the twenty-first in the sheep and goat, the fifteenth to the seventeenth in the pig, the ninth in the bitch, and the eighth in the cat. The body becomes gradually covered with hair.

Weight and Dimensions of the Fœtus at Birth.

The weight and dimensions of the fœtus vary considerably according to the size, breed, and condition of the parents, and other circumstances which more or less influence growth.

The foal and calf at birth vary in weight from 31 to 55 kilogrammes. The average weight of the foal is regarded by Saint-Cyr as between 38 and 45 kilogrammes, or about 0·0685 the weight of the mother before parturition. The average weight of the calf is 32½ kilogrammes, that of the lamb about 4 kilogrammes. In the dog the variation is too great to give an average of any value.

A newly-born foal measures about 3½ feet long, a calf 3 feet, a lamb 1½ feet, a pig about 9 or 10 inches, a puppy 6 to 8 inches, and a kitten about 5 inches.

The other dimensions have not been taken systematically by observers, and hence those given are liable to a large margin of error. It is of course well known that, in a general way, the fœtus is larger than the pelvic opening through which it has to pass at birth, but we ought to ascertain how much larger it is than that canal, and what is the amount of reduction in volume to which it has to submit in passing the outlet of the pelvis. The sterno-dorsal line of measurement of the foal, taken from the summit of the highest dorsal spines to the sternum, is greater than the sacro-pubic diameter of the pelvis of the mother, in some cases by 3 inches, while the lateral diameters at the shoulder and hip joints are slightly less. In that case the fœtus must be compressed from above to below in its passage through the canal. The circumference of the chest of the calf is very much greater than the inlet of the cow's pelvis, and this fact partly explains why it is that parturition in this animal, even when normal, is longer than in the mare. In multiparous animals the young are usually less in circumference than the pelvic inlet; though when it happens that they have only one fœtus, this is often so increased in size that birth becomes very protracted, and may even be impossible.

PREGNANCY.

Gestation, or pregnancy, comprises the period during which the female animal carries its young while this is undergoing development.

Modifications in the Uterus during Pregnancy.

With the development of the fœtus, the uterus undergoes important anatomical and physiological modifications; while the system of the mother also, as stated, participates more or less generally in the phenomena which mark the period of gestation. The modifications and phenomena are worthy of attentive notice, not only from the importance they hold with regard to the reproduction of animals, but also from the practical issues involved in its study. The anatomical changes in the uterus relate to its volume, structure, form, situation, and direction.

In uniparous animals in which the fœtus is developed in one of the cornua, this becomes greatly increased, and appears to be continuous with the body of the uterus, the other horn looking like a mere appendage projecting from its side; but with multiparous females the cornua increase nearly alike in size, owing to their being both occupied by the fœtuses.

The vessels of the uterus, distended with blood, gradually enlarge to a great size—from the smallest to the largest forming most intricate plexuses on and in the texture of the organ. The coats of the arteries are thickened to compensate for their distension and their additional labour, whilst the veins are still more enlarged in calibre. The lymphatic vessels are likewise augmented in number and dimensions, and the nerves also become more numerous. While the organ increases in volume and capacity, its proper structure is exaggerated to an extraordinary degree. This change is most marked in the cornua of multiparous creatures at the points where the young are fixed—in ruminants at the situation of the cotyledons, and in solipeds at the part of the body of the uterus corresponding to the fœtal placenta. In the non-pregnant animal the firmness or density of the organ is always most conspicuous in the cornua, and in the operation of "spaying," or castration of the female, this serves as a useful guide in enabling the operator to distinguish between them and the intestines, which they so closely resemble in appearance. During pregnancy, this density seems to diminish as the organ becomes more vascular, and the cervix assumes a much softer condition than usual. The muscular walls become thinner with the very rapid distension. The mucosa is thicker, redder, more pulpy and vascular, than before impregnation; the longitudinal rugæ gradually disappear, and the utricular glands enlarge—they are longer and wider, and their secretion is increased. The uterine cotyledons of ruminants grow quickly, and there can be no doubt that new ones appear Rainard speaks of examining the uterus of several calves and lambs, and finding only thirty or forty cotyledons, while after parturition he has counted more than a hundred. In the uterus of a six months pregnant cow, Franck found that the horn containing the fœtus had forty-seven cotyledons, and weighed 3·54 pounds; while the other

horn had only forty-two cotyledons, and weighed no more than 0·22 pound.

A new glandular apparatus now makes it appearance in the form of a large number of small openings in the mucosa, each leading into a depression, which is really a "crypt" formed in the hypertrophied tissue of the uterus—a kind of open follicle placed in the interglandular portion of the mucous membrane. These crypts are new structures formed during pregnancy, and are for the lodgment of the villi that project from the chorion of the fœtus, being, in fact, the maternal portion of the placenta. They are small, straight depressions, lying more or less closely together throughout the whole of the uterine mucous membrane of the mare. In the cow these crypts are assembled on the surface of the cotyledons, of which they constitute nearly the entire mass during pregnancy. In the bitch they are only developed where the ovum is fixed, forming then a glandular layer occupying the contour of the uterine cornu.

The utricular glands do not open directly on the crypts, but on a definite surface of the mucous membrane between the crypts, and pour out their secretions, the uterine milk.

The outer or serous membrane of the uterus is also hypertrophied, the broad ligaments are increased in every direction, but especially in length, and their muscular fibres are abundantly developed between their serous layers in order to give them sufficient strength to sustain the weight and maintain the position of the greatly enlarged organ.

The greatest increase of all noted in the texture of the uterus occurs in the middle or muscular tunic. The muscular fibres increase in size and number, and the contractile power of the organ therefore increases. The inner layer, composed of circular fibres, is most conspicuous in the cornua of carnivorous animals, and there they contract in the interspaces between the young, so as to form well-marked constrictions. The fibrous tissue between the muscle fibres also increases in amount.

The uterus likewise acquires a higher degree of sensibility, doubtless from the development of its nerves. The contractility of the uterus is sometimes evidenced before parturition, when animals have been killed and quickly opened. Even in unimpregnated animals these contractions are

present, though they are most energetic in the pregnant animals, as noted by Haller and Colin. In multiparous animals—*e.g.*, cat and bitch—the contractions are most energetic at the constricted places between the fœtuses. These uterine contractions are spontaneous, and in all probability their rhythm is analogous to that of the intestines, extending from the extremity of the cornua towards the cervix in a peristaltic manner, particularly in those animals which, like the bitch and pig, have very long cornua, with the young arranged one after another in them. They become more active and stronger under the influence of a slight irritation. Between the uterus and other genital organs there is established a sympathetic relation that is sometimes not advantageous. Irritation of the cervix may bring on violent contractions of the whole organ, and lead to premature expulsion of the fœtus. This expulsion, as is well known, sometimes follows copulation, though as a rule animals do not usually seek to copulate during pregnancy, if left to their own instincts. It may also be a consequence of manipulation by the hand during exploration of the vagina. Sometimes it follows ovariotomy in the early stages of gestation. The contractions of the uterus are most powerful during parturition, after which they gradually diminish. They frequently embarrass or paralyze the arm of the operator at that time in examining or adjusting the fœtus for its expulsion. This contractility enables the uterus to contract on itself after delivery, and to nearly obliterate its cavity. This rapid diminution in the capacity of the organ closes the orifices of the vessels of the mucosa, and thus prevents fatal hæmorrhage, and may even prevent the entrance of pathogenic organisms into the cavity.

Its main function, however, appears to be concerned in the expulsion of the fœtus, and then, as at other times, it is entirely independent of the will. Besides, the intensity of the contractions is not always related to the strength of the animal; pain deadens and paralyzes the contractile force. When the contractions have been vigorous, the uterus rapidly diminishes; but if they have been slow and weak, the organ slowly contracts on itself. The cause of this slowness is to be found in the expenditure of its contractile power, either

through excessive distension, a delivery too prompt or too slow, or the general weakness of the maternal system.

Narcotics generally produce the same effect, and are therefore successfully administered when the contractions are too

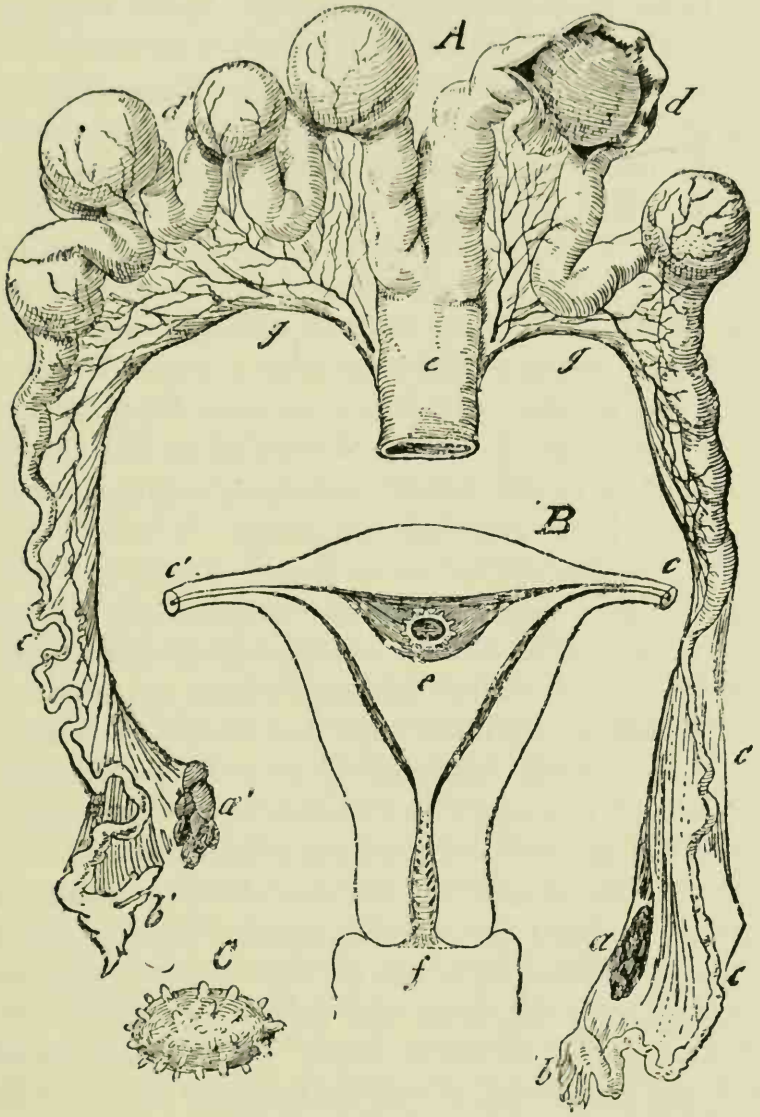

Fig. 53.—A, Uterus of a Multiparous Animal; B, Uterus of a Uniparous Animal; C, Ovum.

d d', Fœtuses in horns of uterus; *e*, body of uterus; *c c'*, Fallopian tubes; *a a'*, ovaries; *b b'*, fimbriated extremity of Fallopian tube: *g g*, uterine broad ligaments; *f*, vagina.

energetic or painful during delivery or before abortion. The contractions are stimulated by irritation of the cervix or body of the uterus—such as is produced by retention of the whole

or portion of the placenta, titillation of the cervix by the finger, frictions on the belly, the application of cold to this part, or the administration of ergot of rye.

After conception the uterus changes in form to adapt itself to the fœtus during its development. In the mare, cow, and sheep, when there is but one fœtus, it is contained in the body and one cornu (usually the right). These portions of the uterus accordingly become enlarged and oblong or globular, while the other cornu is relatively smaller and contracted, and looks a mere appendage. Occasionally the fœtus develops transversely in the two horns. In multiparous animals like the sow and carnivora, the fœtuses are distributed uniformly in both horns, and these become enlarged over the fœtuses, so that they present alternate dilatations and constrictions. Usually the number of fœtuses in each horn is equal. In these species also no fœtuses develop in the body of the uterus, and it is not until parturition commences that the fœtus passes backwards into the latter.

During pregnancy the os is firmly closed and filled with a plug of thick, adherent glutinous matter. The cervix of the uterus widens at the termination of gestation, and looses its constriction as well as its longitudinal mucous folds. Its texture becomes gradually soft and elastic, it diminishes in length, and projects only slightly into the vagina. At a late period, indeed, it appears as a mere ring separating the uterus from the vagina, and is sometimes a little open.

The increase in size and volume of the uterus causes it to change its position during pregnancy. At first the body of the uterus is contained in the pelvis. Later in the *mare* the uterus gradually displaces the pelvic flexure of the double colon, and passes forwards below that viscus, towards and beyond the umbilicus, to rest on the floor of the abdomen in proximity to the diaphragm, stomach, and liver, near the termination of pregnancy. In its development it is situated chiefly in the middle line of the body, slightly inclining to the left, because of the fixed portion of the colon and cæcum in the right flank.

In *ruminants* the gravid uterus passes into the abdomen, and extends between the right sac of the rumen and the abdominal wall. In *multiparous* animals, in which the young

are placed end to end in the cornua, the latter rest on each side of the abdominal floor, and curve upwards, sometimes they are curved in their length. In the *pig* they incline somewhat to the right side.

To facilitate these changes in position of the uterus, the broad or lateral ligaments become unfolded and lengthened. The cervix, firm and resisting, approaches the vulva, and to such a degree sometimes that in certain cattle—particularly those which have a wide pelvis inclined backwards, and bear large calves—the posterior portion of the vagina appears between the labia of the vulva a month or more before parturition, and especially when they lie down. In other cows with very dependent abdomen, the uterus, in passing forwards and downwards, carries the anterior portion of the vagina behind it. The vagina is thus lengthened, the cervix shortened, and the vulva appears to be buried between the ischial tuberosities.

The direction of the uterus in the domesticated animals, because of its weight and their horizontal position, is chiefly antero-posterior, in a line with the long axis of the body. Only in a case of hernia at the flank or through the prepubic tendon does the uterus incline to one side. In cows with a very wide and pendulous abdomen it becomes directed downwards and forwards, but this is quite physiological. In other cases the uterus becomes twisted to the right or left on its long axis, in torsion of the uterus.

The increase in volume and the various changes which the gravid uterus undergoes bring about alterations in, and frequently derangement of, certain functions. Fortunately, however, these alterations are slow and gradual, so that the different organs concerned generally adapt themselves to their changed condition without much inconvenience. The animal becomes lazy and slower in movement, and is more desirous of quiet and tranquillity as gestation advances. These indications are observed at an early period. At the same time the abdomen enlarges and changes its shape; it becomes rounded, and projects below and on each side beyond the crural region; while the flanks become hollow, the croup and thighs wasted-looking, and the sacrum and external angles of the ilium more salient. Immediately after gestation commences the appetite is increased, more use is made of the food in the

economy, and there is a notable tendency to fatten. After the middle period of gestation wasting becomes more apparent, due to the increased demands of the fœtus and the enlargement of the mammary glands. Digestive troubles are not common. In the later stages of gestation there is a tendency towards constipation. Then, also, the uterus presses the abdominal viscera against the diaphragm, and hampers the action of the muscle. The respiratory movements become more numerous, and the animal is easily distressed by exertion. The circulation also experiences some changes. Although the heart has not been shown to undergo dilatation or hypertrophy, as occurs in woman, the blood-supply to the uterus is increased, and the blood becomes increased in amount. Hence, the increased work put on the circulatory system explains the tendency to the production of œdema at the dependent parts of the body, especially the posterior limbs and abdomen. There is no appreciable alteration in the number of red blood-corpuscles, but the number of leucocytes is increased.

The Position of the Fœtus in the Uterus.

The position of the fœtus in the uterine cavity is very nearly constant in the same species, and this position it retains more or less until near parturition, when it is changed. No doubt changes in position may be brought about by the movements of the fœtus and mother.

Burgnone states that at the ninth or tenth month of gestation the fœtus, with its head directed backward, is bent so that the mouth touches the breast, the body forms an arch of a circle, the limbs are flexed, and the croup and haunches are at the bottom of the uterus. According to Colin, towards the termination of pregnancy the fœtus of the mare lies with the belly upwards, the hind limbs in the longest of the uterine cornua, and the anterior limbs and head directed towards the cervix. In the cow the body of the fœtus is curved and much inclined, and looks as if almost lying on one side, and the limbs are flexed. The belly of the fœtus of ruminants is directed downwards according to Colin, and the head is directed backwards.

In multiparous animals the fœtuses are distributed in the

two cornua, one after the other, the head being usually turned towards the cervix uteri, sometimes to the opposite side, and the abdomen lying towards the concave, attached portion of the cornua. In the sow the young are directed forwards, and the abdomen and limbs are directed upwards because of the attachment of the placenta to the roof of the cornua.

The position of the fœtus towards the termination of gestation may vary occasionally, and even frequently, owing to the active reflex movements which it performs; and to those energetic movements, it cannot be doubted, are due the difficult presentations which the fœtus offers so frequently at birth.

Signs of Pregnancy.

The signs which announce pregnancy are numerous and varied, though they are not all reliable, and several are very deceptive and not peculiar to gestation. The diagnosis of pregnancy is not always easy, and it is all the more difficult as the stage is early. During the very earliest period it is impossible to ascertain the condition of the animal with any degree of certainty.

For convenience in description, it is customary to divide the symptoms of pregnancy into three categories, as follows: (1) The rational, physiological, or subjective signs; (2) the material or objective signs; (3) the sensible signs derived from manipulation of the animal.

Rational Signs consist in modifications brought about in the economy of the pregnant animal, and manifested by alterations in temperament, character, and aptitudes. They are frequently deceptive.

One of the earliest is the *cessation of heat.* The female becomes more tranquil, does not exhibit any desire for the male, and even becomes aggressive on his approach. Even males frequently refuse to approach pregnant females.

In some cases the symptoms of heat persist for some time after coition, and in exceptional instances the heat will return after having disappeared for a time. When in this state the female may again accept the male, and it may even happen that a second fecundation takes place at this time, thus occasioning those somewhat unusual conceptions

which give rise to superfœtation, though if pregnancy is somewhat advanced it is dangerous, and may cause abortion. A story is told of a mare in the Saint-Leger stud, France, which, after being pregnant for some months, yet showed symptoms of heat. Louis XIV., who was more inclined to favour the desires of the animal than to listen to the opinion of Garsault, the famous equestrian of that period, ordered her to be put to the stallion. This was done, copulation took place, and the mare aborted. It is an almost certain sign of pregnancy *when the bull refuses a cow*, though the latter may be in heat. With sheep œstrus may continue after fecundation, and the ram may copulate with them. It will thus be understood that cessation of œstrus and the refusal of the female to take the male are not constant, although notable features to be inquired into in examining an animal for pregnancy.

It is generally observed, also, that *a change takes place in the character of the animal* which has conceived, and this sometimes immediately after gestation commences. Mares which were previously vicious, troublesome, or unsteady when in heat, are nearly always tractable when in foal. If not fecundated, the vicious mare becomes even more intractable. In the cow this is also sometimes seen, but not so frequently or so pronounced as in the mare. The other animals are seldom so irritable in their disposition as to lead anyone to notice a similar change in them.

A *tendency to fatten* is frequently noted in the early months of pregnancy of the cow and sheep, and this is taken advantage of by graziers to get these animals in good condition for the market. But in the cow towards the last three months, and in the sheep and pig at the last month, when the mammæ begin to enlarge, there is a tendency to lose condition. In cows the appetite may become depraved. In the later stages of gestation pregnant animals become less capable of withstanding fatigue; they *become sluggish*, and their paces slower and heavier. Sometimes, though rarely, mares will perform their work without any perceptible changes up to a brief period before parturition. At pasture, cattle and sheep are more tranquil, and rest much, as do also pigs and bitches.

Material, Physical, or Objective Signs are those depending upon the change in volume of the abdomen and the mammæ, the appearance of the milk in the latter, alterations in the composition of the urine, and increase in weight of the animal.

The *abdomen enlarges in every direction*, and at the same time changes its shape at a rate corresponding with the development of the fœtus. It descends, or "drops," the flanks become hollow, and the spine appears more concave in the dorso-lumbar region; while the lateral portion of the croup sinks so much as to make the sacrum and haunches towards the root of the tail look more salient. It is most noticeable when observed from behind. These phenomena commence in the mare three or four months after conception, seldom before the fourth or fifth week in the bitch, and are progressively developed as gestation approaches its term. They are, however, irregular in their appearance, and inconstant. In some animals there is little change until near parturition, and in others, generally those at pasture, or which have had a number of foals, the abdomen is naturally well developed and pendulous, so that any increase in size is not appreciable.

Besides, some diseased conditions, as ovarian dropsy, uterine polypus, hydrometra, ascites, impervious vagina, etc., may give rise to amplification of the abdomen. Of itself, therefore, this is not at all a sure criterion of pregnancy, but is of some value. Recourse to measurement of the abdomen at regular intervals has been recommended to make sure of any change in its size.

The *enlargement of the mammæ* begins in primiparous animals soon after conception, towards the second or third month in the filly or heifer. The mammary glands are more prominent and firm to the touch, lose their wrinkles, and the teats are more visible. In primiparæ, also, the glands towards the last third of the period of gestation furnish a yellow, viscid, transparent liquid which can easily be extracted from the teats by milking. In some, in the early stages, a drop or two of a water-like fluid may be furnished in this way, but later on it increases in quantity, and becomes viscid. In the last weeks of pregnancy this liquid becomes white and opaque. When the animals have bred several times, the increase in

size of the mammary gland is only remarked in the last days of gestation.

In milch cows which are not good milkers, the udder even decreases in size, and becomes less active, about the twentieth day after conception. In the pregnant mare running with foal, the secretion of milk also ceases in seven to nine months.

In animals which have borne young, the mammary glands undergo their enlargement later than in primiparæ. The changes in the mammary gland are more constant in the smaller animals. In milch cows under ordinary conditions, the quantity of milk diminishes at the sixth or seventh month. In the non-pregnant female of various species, the secretion of milk may appear naturally, or be induced by mulsion or frequently repeated suction of the teats, even in very young creatures, shortly after birth. In the unimpregnated bitch, lactation may appear under conditions referred to on p. 56.

A method of determining pregnancy in cows, according to the character of the milk, has recently been described. It is said to have been practised in India for ages. A drop of milk from the animal under consideration is dropped from a clean straw into a tumbler of water. If the cow is not in calf, the milk at once mixes with the water with a flocculent cloudiness. If she is pregnant, the drop falls to the bottom of the glass with hardly any mixing.

In the urine, the salts of lime have been said to diminish according as they are required by the fœtus, but there is not sufficient evidence to make a general statement on the subject.

An *increase in weight* is an evident accompaniment of the growth of the fœtus, and on that account regular weighing of suspected animals has been proposed. The mucous membrane of the vulva and vagina becomes swollen and of a red or bluish-red hue. Towards the termination of pregnancy, the secretion of vaginal mucus, particularly in the cow, is largely increased. All these numerous signs are by no means constant or reliable, and the chances of error in the diagnosis of pregnancy in the first half of the period are numerous. If the symptoms are all present, they establish a strong presumption of pregnancy. It is not until a later

period, when the abdomen begins to increase more rapidly in volume, the animal becomes sluggish, and the mammæ enlarge and secrete the viscid fluid above described, that the existence of pregnancy may be safely affirmed.

Sensible Signs.—Towards the end of pregnancy the movements of the fœtus become vigorous and unmistakable, and at times they may be observed or felt on the abdominal wall. Various expedients have been resorted to in order to excite these movements and make them more easily felt. Some of them are exceedingly objectionable, and may produce abortion. Such are the following two methods: (1) The pouring of water into the ears of the mare and cow, under the supposition that if the animal is not pregnant it will shake its whole body to get rid of the fluid, but if pregnant that it will only shake the head and ears; (2) giving the animals fast exercise, and then offering them cold water to drink and food to eat immediately afterwards, in order to induce energetic movements of the fœtus.

Manipulations of the abdomen to ascertain the presence of the fœtus do not yield equally certain results in all the domesticated animals. In the small species, such as the dog and cat, this method is very effective from the middle period of gestation onwards. In the larger animals the results are not so satisfactory. In the cow, after the fifth or sixth month, the presence of the fœtus can be readily ascertained by this means, but in solipeds not until the seventh or eighth month; and even then the method is rather difficult to apply, because of their fidgetiness and their tendency to render the abdominal muscles tense. It is better to examine the animal when it is standing. The examiner stands on the right side of the cow, the left of the mare, with his back towards the animal's head, and presses the palm of one hand moderately against the abdomen immediately below the flank, about 6 or 8 inches in front of the stifle, and just above the udder, the other hand resting on the back. At this part of the abdomen a hard voluminous mass can be felt in the uterus, while the movements of the fœtus are perceptible as it stirs at irregular intervals. These movements are strongest in the morning, and are more distinct if the mother drinks cold water, or after feeding, especially if exercise has been previously taken.

Cold water thrown against the abdomen, or the application of the cold wet hand, will produce a similar effect. In the cow, smart compression of the abdomen with the closed fist at the part just indicated, so as to push the uterus and allow it to return with a little force, when it may be felt as a firm voluminous mass, will prove successful in ascertaining the presence of the fœtus when the application of the flat hand will fail. This is best carried out when there is not much food in the alimentary canal. At a more advanced period the movements of the fœtus can be easily remarked on the abdominal wall. They are especially energetic, even convulsive, immediately before abortion at a late portion of gestation. The absence of these movements is not quite conclusive, and the examination should be carried out several times in doubtful cases.

To distinguish pregnancy from ascites, one observes that the uterine tumour is firm, hard, elastic, and defined, whereas in ascites the swelling is not defined, there is no repercussion on compression at the flank, and the feel is not firm or elastic. In addition, fluctuation can be made out on palpation in ascites. In tympanites, also, the swelling of the abdomen is tense, and resonant on percussion.

Rectal exploration is also a valuable aid to diagnosis of pregnancy, but can only be successfully carried out in the larger animals, because in the bitch and cat one cannot reach far enough forward to manipulate the cornua. In the large domestic animals the diagnosis of pregnancy by rectal examination can be made with certainty at and after the third month. For this examination the hand and arm, lubricated with soap, oil, or vaseline, are carefully introduced into the rectum to beyond the brim of the pubis, the hand is opened, and the palm directed downwards towards the floor of the abdomen. In the cow evidence suggesting pregnancy can be got in this way from the sixth week onwards. The horns of the uterus are asymmetrical, the one in which the fœtus develops is enlarged, appears to contain fluid and fluctuates on palpation, and the uterine wall appears thin. After the third month, the form of the fœtus, the head or other part, may be felt through the uterus and the fœtal coverings, and it is possible to displace it. The uterine cotyledons can readily be discovered in the

cow. If the pregnancy, however, is not advanced beyond the sixth month, the fœtus cannot be readily felt, as it lies low down in the abdomen, or well forward in one of the horns of the uterus, and to one side of the mesial plane (nearly always to the right in the cow). Hence the hand must be carefully moved to the right and left so far as the intestines will permit. In some cases, where the abdomen is large and pendulous, it is useful to place the animal higher in front than behind, and have the belly raised by assistants on each side by means of a sheet or sack, or their hands joined underneath, so as to throw the uterus upwards and backwards. The fœtus should be excited to move, if possible, so as to guarantee its presence. This method is without danger to the animal so long as it is carried out with reasonable care. The presumption of life in the fœtus is made from the evidence of fœtal movements. During rectal exploration care should be taken not to mistake the contents of the rumen or of the intestines for a fœtus, the form and movements of which are quite characteristic.

Vaginal exploration may also be practised, but it is not nearly so valuable, and it is not free from the danger of inducing abortion. In cows, however, examination per vaginam is often carried out without untoward results. The presence of a plug of tough mucus completely filling the os uteri is an important feature of pregnancy.

Auscultation has not been much employed in the diagnosis of pregnancy in the lower animals, and has not proved of such service as in the human subject. The sounds to be heard consist of the short, regular, double pulsations of the fœtal heart, which are much more frequent than those of the adult. In the larger animals, auscultation of the abdomen for the purpose of discovering the existence of these sounds is very often unsuccessful, because of the intestinal walls, the rumblings and noises of the intestines, and those of the rumen in the cow, the large quantity of amniotic fluid, the position of the fœtus, the restlessness of the patient, which entirely mask the bruits of the fœtal heart. Lafosse, Hollmann, Saake, and others, have been able to hear the fœtal sounds in the cow from six months onwards, the beats varying

from 113 to 128 per minute, while the mother's pulse varied from 68 to 84. To examine the heart sounds of the fœtus in the cow, it is necessary to place the ear or the stethoscope over the abdominal wall at the lower portion of the right flank, in front of the fold of the thigh. Saake considers it best, in the mare, to auscultate over the umbilicus. Auscultation by the vagina is suggested by M. Trasbot, but does not appear to be a practicable method.

From what has been said of the signs of pregnancy, it will be perceived that in the early period of this condition there is but little more than supposition to guide us, the presumption becoming stronger as the physical and other indications are more marked. It is only, however, towards the middle period, when all the rational and physical signs are present, and when the condition of the uterus is ascertained by the exploratory manœuvres above described, that we can affirm, without the danger of error, the existence of pregnancy. Even then, although symptoms are not very definite, one must be careful in expressing an opinion as to the absence of this state. All the methods of examination available should be taken advantage of in doubtful cases, and if necessary repeated, a guarded opinion being finally given when no evidence of a fœtus is obtained.

DURATION OF PREGNANCY.

The duration of pregnancy varies considerably in different species of animals, and, even to some extent, in individuals of the same species.

No satisfactory relationship can be established between the duration of pregnancy and the other conditions of organization, such as size or longevity. In closely allied species—such as the horse and ass or the sheep and goat—the period is pretty nearly the same.

The Hungarian cow, according to Wilhelms, averages ten days longer than the Dutch cow. With the male fœtus, the duration of gestation is greater than in the case of a female. A mare which has been put to a thoroughbred horse will be longer pregnant than when impregnated by a common-bred stallion; and the mare which has been fecundated by a

stallion ass goes longer than when impregnated by a horse. A weakly or much-worn animal does not go as long as one which is strong and well fed. Differences in individuals of the same breed or species may be partly accounted for by variations in the interval between copulation and fecundation of the ovum. The spermatozoon may meet the ovum in different portions of the Fallopian tubes or uterus, and that would depend to some extent on the relation between copulation and ovulation. This variation cannot extend to more than a few days. With some animals, also, the fœtus may apparently remain for a number of days in the uterus after it is ready for birth, without inconvenience to the mother or itself, just as it may be born for several days before the ordinary period without compromising its safety.

Mare. — The usual period of gestation with the mare is eleven calendar months, or 340 days, though it may vary between ten and twelve months. According to the observations of Winter, Brugnone, Tessier, and Grille, made on 284 mares, the shortest period was 307 days, the longest 394 days, and the mean duration 346 days. According to Count Schudorff, from 8,300 observations, the average duration of pregnancy was calculated at eleven months and three days. Dieterichs gives the shortest period as 307 to 317 days, and the longest as 409 to 419 days, the average being 336 to 342 days. Baumeister and Rueff give a minimum of 330 days, a maximum of 420 days, or fourteen months; the average as 340 days. According to the latter, also, with pure-bred Persian mares the period of gestation was 341 days —343 for male foals, and 338 for females; in thoroughbred Arab mares the average was 338 days—339 for males and 337 for females; in high-bred Russian mares, some of the Orloff race, the average duration was 341½ days—341 for males, and 342 for females. With English mares, they found that in half-breds the average was 339½ days—340 for males, 339 for females. The average duration of pregnancy with thirty-three thoroughbred mares at Middle Park Stud, Eltham, in 1876, was 335½ days. Seldom are foals born alive before the 300th day. After the 400th day the gestation is not normal or physiological. Pregnancy is often, as noted above, a little longer for a colt than a filly. Even in different

studs there would appear to be differences in the length of gestation. In cases where the mare is put to the horse more than once, it is possible that a certain margin of error may arise in reckoning the period of pregnancy. It is generally admitted that pregnancy is of longer duration in the ass than the equine species—from 358 to 385 days. From records in this country, it appears that the shortest period of gestation in the ass in eight entries was 365 days, and the longest 385 days, in two cases. The mean period was 374 days. When the female ass has been covered by the horse stallion, the period of gestation is not so long.

Cow.—The average period of pregnancy in the cow is about nine months, or thirty-nine to forty weeks. In 1,062 observations the mean period was 283 days. Colin gives an average of from 280 to 285 days. Dieterichs gives the shortest period as 210 days, the longest as 353 days, and the average 286 days; while Baumeister and Rueff give the shortest as 240 days; the longest, 330 days; and the average, 285 days. The average of the Bernese Simmenthaler breeds at Hohenheim was 280½ days: male calves, 283 days; and cow calves, 278 days. Earl Spencer, after 760 observations, gives an average of 284 to 285 days. Gestation is usually longer for a male than a female calf, although in Earl Spencer's statistics the opposite held good. In the improved breeds generally the period is shortened.

Sheep and Goat.—The sheep and goat go with young about five months. In 429 observations, Magne gives the shortest period as 143 days, and the longest, 156 days, the average being 149 days. Colin gives the average as 151 to 152 days; Dieterichs gives the shortest period as 146 days; the longest, 157; average, 151 days; and Baumeister and Rueff state the shortest period in the sheep and goat as 135 days; the longest, 160; average, 144 days. In Merinos the period of gestation averages 150·3 days, and in Southdowns 144·2 days. The gestation in the goat is prolonged some days beyond five months.

Pig.—The pig is usually pregnant four months, or, as more commonly stated, three months, three weeks, and three days. Baumeister and Rueff give the longest period as 130 days; the shortest, 110; the average, 120. Dieterichs gives

109, 133, and 115 or 116 days; Magne, 109, 120, and 113 or 114 days; Rainard, 104, 127, and 119 respectively.

Bitch.—The bitch goes with young about two months, or from 58 to 65 days, the average being 63 days, or nine weeks. Baumeister and Rueff state the shortest period to be 55 days, and the longest 70, the average being 60 days.

Cat.—The cat is pregnant from 50 to 60, 62 or even 64, days, the average being 55 days, or eight weeks.

The average periods of gestation in the following animals are—Elephant, 20 months; the zebra, 13 months (or over); the camel, 45 weeks; the rabbit, 32 days; and the guinea-pig, 63 days. It is curious that the guinea-pig should go twice as long as the rabbit.

NUMBER OF YOUNG AT BIRTH.

The mare, ass, and cow, are uniparous—*i.e.*, usually produce only one at birth. The sheep and goat are said to be uniparous, but frequently produce twins. The pig, bitch, and cat, are multiparous—*i.e.*, usually produce several young at birth.

Multiparity is due to the simultaneous ripening of two or more Graafian follicles, their rupture, and the escape and fecundation of the contained ova. This fecundation takes place frequently after a single coitus, and the membranes of each fœtus are separate; sometimes it occurs after several acts of copulation, and in that case there may be distinct intervals between the ejection of each fœtus at parturition. Multiparous animals may be impregnated at a single copulation, and bring forth several young. Yet as a rule they are fecundated more than once, and, in fact, do not cease to seek the male until after several copulations. In twin pregnancy, the two ova may have occupied one Graafian follicle, and that would explain the fusion of the fœtal membranes in some instances. Uniparous animals in varying proportion have been known to give birth to two or more young, and then the period of gestation is usually shortened, and the weight of each of the progeny less than in single births.

Of all the domesticated animals, the *Mare* is the one which least frequently brings forth more than a single creature at birth. The proportion is estimated by Rueff at 1 in 250; by

Cornevin as 1 in 1,000; by Baldassare as 0·9 per cent. Usually, when more than one foal is carried, they lead to premature birth about the eighth or tenth month, and seldom live. If they do live, they are frequently weaklings, and therefore undesirable. Occasionally a mare produces twins on several successive years. Saint-Cyr records the case of a mare which was put to the horse only once, on February 17, 1843, and aborted during the night of September 27-28, two foals being found in one chorion; on the 25th of the following February it produced a third foal perfectly formed, and which lived. It is exceedingly rare for triplets or quadruplets to be recorded in the mare.

The most numerous instances of twin or triple gestation in

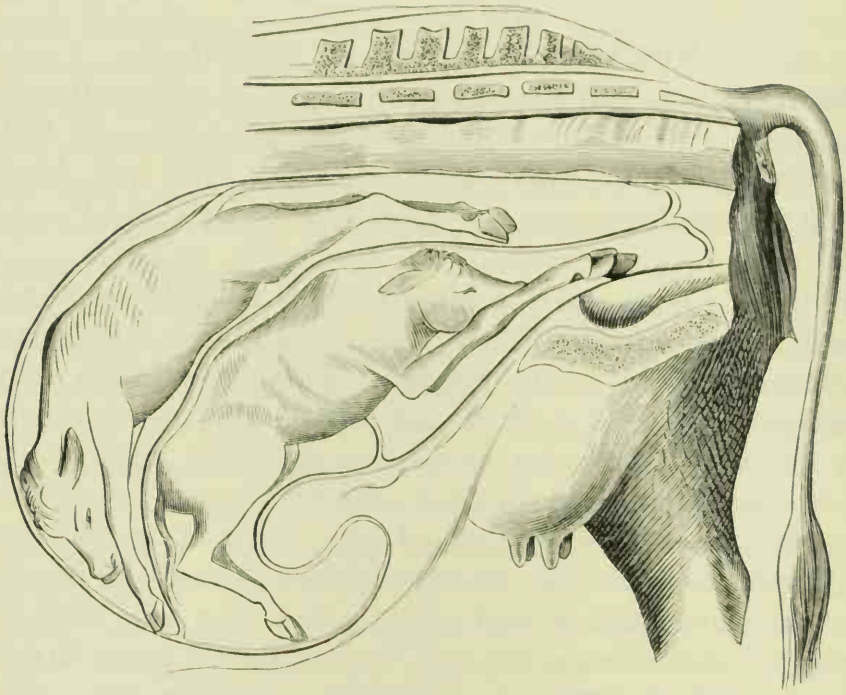

FIG. 54.—TWIN PREGNANCY: COW. (SAINT-CYR.)

the mare are to be attributed to two successive fecundations. The mare has been put to the horse and ass stallion in succession, usually within a day or two, and brought forth a foal and a mule. The female ass brings forth twins more frequently than the mare. Among thirty she-asses, only four had twins in a period of seventeen years. According to Cornevin, she-asses have one twin in every hundred births.

Cow.—Double or triple births are not so unusual in the cow, the former being far from uncommon, and then the

Cow.—Double or triple births are not so unusual in the cow, the former being far from uncommon, and then the tendency to abortion is not marked. Usually twins are not carried quite so long as a single fœtus. Rueff says that, with the Simmenthaler breed of cattle at Hohenheim, during an interval of ten years, there were 4 per cent. twin births. Triple or quadrigemellar gestation is also not rare, but quintuple pregnancy is seldom observed in the cow; exceptionally, six and seven fœtuses at a birth have been recorded, but seldom lived. Frequent cases are recorded of a succession of multiple pregnancies in the one cow. Cows have twins in every ninety births (Cornevin).

Free-Martins.—In twin pregnancy in the bovine species, when the young are of different sexes, the female is generally unproductive, and is called a free-martin. This anomaly has been said to appear also occasionally in the goat. The fact that twin calves are sometimes unfruitful is well known in many countries. The free-martin is what is regarded as the female. It is very rare indeed that the male is infecund; Baumeister, however, describes an instance in which a bull—a twin—was put to a hundred cows, none of which produced a calf. The free-martin has all the external marks of a cow calf—namely, teats and external female parts, called by farmers the bearing. It does not show the least inclination for the bull, nor does he bull take the least notice of it. It very much resembles the bullock or spayed heifer (Hunter). The vulva is exceptionally small, and the vagina is a cul-de-sac. Internally, in some instances the uterus is undeveloped; testicles more or less developed alone are present in place of ovaries. The clitoris is sometimes enormously developed. Cases of the kind are described by Hunter, Müller, Speigelberg, and others. The explanation of the occurrence of free-martins in bovines depends on the anastomosis of the blood-vessels of the placentæ of the two fœtuses and the intermixture of their blood. In this way the hormones of the male are carried to the other fœtus and dominate over the female hormones and inhibit the development of the genital organs of the female twin.

Ewe.—With sheep twins are very common. In many flocks in a good year half the ewes will have twins. This is

said to occur when Leicester ewes are first crossed with Cheviot rams, and the produce crossed with Leicester rams. In the Dorset horned breed, the ewes are bred from twice a year. In warm climates, especially, multiple pregnancy in the ewe is exceedingly common. In French Flanders, according to Magne, there is a prolific breed of sheep, each ordinarily producing three, sometimes four, five, and six, rarely seven, lambs at two births during the year. Four, five, and six lambs, at a birth have occasionally been recorded in the ewe in this country. The finer breeds of sheep, such as the Merinos, are usually uniparous, much more so than the coarser breeds. Certain years are also more remarkable than others for multiple pregnancy, and this is attributed to a greater abundance of nourishment.

Goat. — The goat is generally considered a uniparous animal, but double and triple births may be said to be the rule; not at all infrequently four are produced. But usually, with three or four at a birth, one or more is feeble or born dead.

Bitch and Sow.—In the bitch and sow the number of young vary from two or three, up to twelve or fourteen. In a sow, twenty-four young have been recorded at a birth, but the mother died soon after, and in other cases twenty-one and twenty-two young. In the bitch, as many as seventeen and twenty-three puppies in a litter have been recorded. In the smaller breeds of pet dogs, the number of puppies in a litter is usually small.

Diagnosis of Multiple Pregnancy.

The diagnosis of multiple pregnancy in animals ordinarily uniparous is not very certain. The condition may be suspected if the abdomen of the mother is exceedingly large; but even a rectal examination will not, as a rule, enable one to give a definite opinion. The diagnosis is, however, seldom called for, save in the case of difficult parturition caused by the simultaneous presentation of portions of the two fœtuses. Then careful manipulation of the fœtuses through the vagina will distinguish; and it will be found that if portion of the one fœtus is repelled, the other fœtus does not move in harmony, so preventing confusion with monstrosities with

supernumerary extremities. In attendance at an ordinary parturition, where one fœtus has been removed, it is advisable to make a vaginal examination of the uterus to discover whether there are any more remaining in that organ. In the small animals the examination is made only by abdominal manipulation.

Position of the Fœtuses in Multiple Pregnancy.

In cases of multiple gestation in creatures naturally uniparous, one of the fœtuses occupies the ordinary situation of single gestation—the head towards the cervix uteri, the larger proportion of the trunk in the body of the uterus, and the hind-quarters and limbs in one of the cornua. The second fœtus occupies the whole of the other cornu, with the head turned back, or, as occurs not infrequently, in the opposite direction. Ordinarily each fœtus is isolated and enclosed in its own proper membranes. Sometimes the chorion of the two fœtuses adhere by means of fine connective tissue at their points of contact; the placentæ are often confounded (in ruminants), or united by a kind of membranous connection, and in bovines the blood-vessels of the two fœtuses often anastomose. In such a case the young may be expelled from the uterus in quick succession, a common occurrence in the goat (Rainard); but more commonly, after the birth of the first fœtus, the uterus contracts on itself, enclosing the remaining progeny, which may not be expelled for some time later, even a few days. The first expulsion is generally premature. A mare occasionally gives birth to a dead foal after, say, four months' gestation, and at the ordinary time a living foal. If one of the fœtuses dies *in utero* as the result of starvation, the separation of its placenta from the uterus, or the pressure of a very large companion fœtus, it acts commonly as a foreign substance in the uterus, induces contractions of that organ, and is expelled, while the living fœtus remains until the normal time for delivery. In somewhat rare cases the dead fœtus may be kept in the uterus, becomes desiccated or mummified, and is not expelled until after the normal birth of its companion. This retention has been recorded to have lasted in the mare for one or two years.

Sometimes, also, the fœtuses are enclosed in a common

chorion, and provided with one placenta, the two having a circulation in common, through their umbilical vessels communicating by lateral ramifications. In this case the expulsion of one fœtus necessarily brings about that of the other. Occasionally both fœtuses are enclosed in the same envelopes, and then at parturition the same thing occurs as in the last case. Monochorial twins are always of the same sex and very closely resemble one another. Probably they are formed from the two primary divisions of one ovum after complete separation. Rarely, in twin pregnancy, one fœtus is contained within the other by "inclusion," presumably the result of the formation of two unequal individuals from the fission of one ovum. One fœtus has been found in two or three instances within the abdomen of the other (Bartholin and Gurlt).

HYGIENE OF PREGNANT ANIMALS.

The hygienic measures to be observed in the management of animals during gestation are, in general, those which should always prevail, irrespective of this condition. But besides these there are a few particular precautions to be attended to, in order that this period may be safely and successfully passed through, and these precautions are all the more necessary as the period of birth approaches.

With those animals which are employed in labour—as the mare, and sometimes the cow—it is well not to work them severely nor fatigue them much, and especially as pregnancy is advanced. On the other hand, absolute repose is pernicious. Exercise is most beneficial. The most difficult cases of parturition occur among animals to which this is denied. The pregnant mare will accomplish ordinary and accustomed work, particularly if it be slow, without any harm, even with benefit, until the seventh, eighth, or ninth month, when more care must be observed; but moderate exercise should always be allowed up to the period of parturition. Harness is preferable to saddle work for pregnant mares, and fast trotting, galloping, jumping, travelling over broken ground, or severe and sudden exertion, injuries, or shocks of any kind, are to be avoided; in fact, extremes should be guarded against. If the animal must be employed for riding, the use of spurs should be interdicted, to avoid injury to the foal by

sudden contraction of the abdominal muscles. If not put to work, the animal ought to be regularly exercised in hand, or placed in a paddock provided with shelter from inclement weather.

The cow, if employed in labour, may be worked moderately until the sixth or seventh month. If kept for milk production, the milking should also cease about this period. With well-fed cows it is often prolonged until near parturition, but even then it is prejudicial to the fœtus, by diverting into the mammary glands the materials which should be disposed of in the uterus.

Exercise at pasture is beneficial to all animals; even the pig and bitch are greatly benefited by movement. Pregnant animals should be well fed, and especially if they have to accomplish a certain amount of labour or yield milk. The appetite is increased, and there is, as already noted, a tendency to fatten. This tendency should be somewhat guarded against, as it may prove troublesome, particularly if it is allowed to proceed to an extreme degree, when it may retard the development of the fœtus, induce abortion, cause difficult parturition, or give rise to serious after-consequences. This precaution is more to be observed in the second than in the first half of pregnancy, when the food should be plentiful, but not in excess, and the flesh more abundant in the animal than fat. Mouldy or otherwise damaged food should be avoided as usual, as it is likely to prove indigestible and cause tympanites.

Grazing on pasture is favourable to the pregnant condition of herbivorous animals, especially if the land is not too broken or sloping, and the herbage good. Shelter should be provided against inclement weather. If the herbage be not sufficiently plentiful, it should be supplemented by an additional allowance of food. In places where rickets and similar bone diseases are prevalent, phosphates of lime, bran, oilcake, etc., should be given.

The water should be pure and plentiful at all times, as then the animal will drink only moderate quantities. Very cold water and frozen food such as roots should be restricted, as they may cause injury, not only to the mother, but also to the fœtus.

With regard to dwellings, near foaling time—for three weeks or a month—the mare should be kept apart in a roomy loose-box, and, when convenient, within sight of the other horses with which it has been accustomed to associate. Sometimes, when loose in the latter, the mare lies down with her buttocks against the wall during parturition, and the foal is jammed against the side of the box, and its life endangered. Some breeders arrange a special box with false walls, in order to be able to correct the condition when it arises.

The cow is usually allowed to remain in its ordinary stall in the cowshed, but overcrowding and want of space should not be permitted, and every cow towards the end of gestation ought to have plenty of room in its stall, or, better, be given a separate box. The doors of the shed or house or stable should be very wide, to prevent injury to pregnant females; the building should be kept perfectly clean and well ventilated. With stalls, the floor should slope very little indeed, from before to behind, as, if the inclination is at all marked, the weight of the gravid uterus is thrown backwards, and this may lead to abortion, prolapse of the vagina, and even eversion of the uterus. Cases of abortion or impending abortion in a stall or shed among pregnant animals is to be treated as we shall afterwards indicate, when dealing with abortion.

In mild climates the animals may be allowed to foal or calve in the open.

The cleanliness of the animals themselves is not to be overlooked, as neglect of grooming and freeing the skin from dirt must operate perniciously, not only on the mother, but also on the fœtus.

Harsh or cruel treatment on the part of grooms, cowkeepers, shepherds, and others, should be sternly suppressed; and fear, generally produced by young dogs hunting the animals, and particularly pregnant sheep, is especially to be averted if possible. It is advisable not to have animals of other species in the same field or pasture with those that are pregnant, more especially towards the period of parturition.

With an irritable or timid primipara of the larger animals it is well to be gentle, and to accustom it to manipulation, particularly about the udder, in order that it may the more

readily allow its progeny to approach it without danger. Severe surgical operations should be proscribed, especially if they entail the casting or restraint of the animals, unless they are urgently needed for the cure of disease, as they may be hurtful to the fœtus. Drastic purgatives should also be avoided, because, by increasing peristalsis, they indirectly excite contraction of the uterus, which may lead to abortion. Powerful narcotic agents also may imperil the life of the fœtus, even if they do not injure the mother. The bitch may be safely washed a few days before parturition, provided it is done with proper care. A dose of worm medicine may also be given with advantage as far on in gestation as the sixth week, to get rid of worms in the bitch and prevent infection of the puppies after birth.

CHAPTER III

PATHOLOGY OF PREGNANCY

ANOMALIES IN PREGNANCY.

Superfœtation.

The term superfœtation (*fœtus super fœtum*—one fœtus on another) is employed for those cases of conception in which an animal, already pregnant, has been supposed to conceive a second time before the termination of the primary gestation.

This condition must not be confused with superfecundation, in which two or more ova are fertilized during the one period of œstrus as the result of one or more copulations. This latter condition is clearly illustrated when, as the result of two separate copulations with a horse and ass, a mare gives birth to twins, a horse foal and a mule foal.

In superfœtation the second fecundation is supposed to occur when the first product of fecundation has passed through the earlier stages of its development in the uterus. There is a wide interval of time between the two copulations. Superfœtation depends upon the possibility of a spermatozoon passing forward through a gravid uterus containing a fœtus and fertilizing a second ovum. It is only exceptionally that such an occurrence can take place, because pregnancy usually inhibits ovulation, the os uteri is closed, and the body of the uterus is occupied by the first fœtus and its envelopes, save in multiparous animals. The second copulation occurs during an exceptional second period of œstrus.

In the mare, cases of the kind are recorded by Ayrault, Dr. Chabaud, Lanzillotti-Buonsanti, Lemaitre. In some of the cases recorded one of the foals was an abortion or still-born.

In the *Journal des Vétérinaires du Midi* for 1859, Dr. Chabaud relates that in the Commune of Verniolle (Ariège) a mare was put to a stallion ass. As œstrum continued, it was put to a stallion fifteen days afterwards. Nothing unusual occurred during gestation, and when parturition took place a fine healthy foal was born, and after ten minutes' straining, to the astonishment of the owner, a good well-formed mule. The mare suckled the two, and they did well.

Lanzillotti-Buonsanti mentions a mare which, on March 28, 1851, was put to an English stallion, and on April 5 to a barb; on February 28, 1852, it produced two foals, each resembling one of the stallions. Lessona speaks of a mare which was put to a horse in 1852, and sixteen days afterwards to a Persian stallion; at eight months' pregnancy it dropped a horse foal, and in two hours after a mule foal.

Malet publishes also the following case: A mare aged four years was served by a donkey on March 18, 19, and 25, and April 8, 1890, and by a stallion on May 8 following. It gave birth nine months after the last service by the donkey, and ten months after the single service of the stallion, to a mule, first born, and a filly.

In the cow, a case is recorded by Hering in which a cow gave birth to a heifer calf in August, and a bull calf in the following December, both alive and quite normal in formation.

The cases recorded in the larger domesticated animals are, however, as a rule, not absolutely convincing, because a certain interval may occur between two conceptions during the same period of œstrus; and even with twins conceived at the same intercourse, one fœtus often does not develop so quickly, and is not so large, as the other, and is either rejected or retained after a more or less lengthened interval. According to Rainard, torsion of the neck of the uterus in the cow, though preventing the birth of the fœtus, may nevertheless permit new conceptions.

In multiparous animals there can scarcely be a doubt that superfœtation may take place. In these animals the primary fecundation may occur only from one ovary in the corresponding horn, the other remaining open and unoccupied. In the sow and bitch many cases of superfœtation are recorded by Müller, Tapken, Rainard, Blaine, and others.

One sow recorded by Müller, which had been impregnated some weeks after the first impregnation, gave birth first to a litter of six piglings, and twenty-three days later to a second litter of eleven, all well formed and healthy.

Extra-Uterine Pregnancy.

Extra-uterine pregnancy is an abnormal condition in which the ovum develops outside the uterus. From certain causes which are not yet clearly understood, it sometimes chances that the ovum, instead of taking its normal course, either remains in the ovary, is arrested in its progress through the Fallopian tube, or, escaping the fimbriated extremity of the latter, falls into the peritoneal cavity, or glides between the folds of the broad ligament or between the serous and mucous membranes of the uterus; in all of which situations Nature makes an effort to afford space and nutrition for the embryo, and thus supplies the place of the uterus. The effort, however, as might be anticipated, is only partially successful, and, after attaining a more or less imperfect development, the fœtus perishes from lack of nourishment. This abnormal deviation from ordinary gestation is very rare in the domesticated animals, even more so than in woman. The varieties of extra-uterine pregnancy are the following:

1. *Ovarian fœtation*, when the ovum is retained in the ovary. Here the embryo may develop in the Graafian follicle or interior of the ovary (internal ovarian), or the ovum leaves the follicle and develops under the germinal epithelium (external ovarian). The only instances on record are given by Rohlwes, Gurlt, and Plot. Rohlwes observed this rare condition in a mare which had been pregnant twenty-one days. Plot observed it in a cow, and also in three sows. The ovum must have been impregnated while still in the ovary by the spermatozoon.

2. *Tubal pregnancy*, when development takes place in the Fallopian tube. If the ovum is lodged at the fimbriated extremity of the Fallopian tube, the gestation is called ovario-tubal, and if lodged at the uterine end it is called utero-tubal. Rohlwes has found the bone of a fœtus in the left Fallopian tube. Carsten Harms speaks of it as causing fatal internal hæmorrhage, by rupture of the tube, through the incapacity of the latter to distend sufficiently for the development of the fœtus.

3. *Interstitial pregnancy*, the form in which the embryo is developed between the membranes forming the wall of the

uterus. The muscular fibres are separated, and the fœtus within its membranes is situated between the serous and mucous coat of the uterus at the junction with the Fallopian tube. This form has not been noted in the lower animals.

4. *Abdominal* or *ventral fœtation*, the form in which the ovum may graft itself, after escaping from the ovary, directly in the cavity of the abdomen, and there be developed (primary); or it may be developed at some other point, such as the ovary, Fallopian tube, uterus, etc., and fall into the abdomen after rupture of the pouch which contained it. The first variety is the more uncommon. In the other forms the fœtus may still retain its attachment, through the umbilical cord and fœtal membranes, to the organ from which it has escaped.

5. *Vaginal gestation*, in which the ovum is implanted and becomes developed in the vagina. It has been recorded in the larger animals, particularly the cow.

The length of time during which these extra-uterine fœtuses may be retained varies according to circumstances. In woman the fœtus has remained in the abdomen from three months to fifty-six years. In animals the retention of the misplaced fœtus may also continue for a long time; and though death usually occurs, if delivery is delayed much beyond the normal period of pregnancy, yet development appears to progress in the ordinary manner, and subject to the laws of normal gestation. The chorion develops a placenta, and becomes attached to peritoneum or other membrane in a similar manner to the mucous membrane of the uterus, and these receive an increased blood-supply.

Symptoms, Course, and Termination.—The symptoms are generally those of conception and gestation. In the majority of cases, when parturition should occur in the usual course, the premonitory indications of that phenomenon are very slight or altogether absent; though the animal may now and then make expulsive efforts, which continue, perhaps, for a few days, and then subside gradually or recur at intervals.

In the most favourable cases, when the fœtus perishes, it becomes encysted and mummified; the fluids and soft parts are absorbed, and the remaining portions become dry and parchment-like; or the creature may undergo a process of calcification by the deposition of carbonate and phosphate of

lime in its tissues, which preserve its shape and convert it into a *lithopædion* or *osteopædion*. In this condition the fœtus may remain for a long time in the abdomen of the mother without causing much, if any, inconvenience; indeed, a most perfect state of health may exist, and the animal may become remarkably fat, or it may again conceive, and bring forth as favourably as if nothing abnormal existed; the indications of anomalous gestation being only discovered by chance, when the animal dies from some disease which has no relation to this accident, or is killed for food.

The chances, however, are many that a fatal termination will be the consequence of extra-uterine gestation. Expulsive efforts or other causes may lead to rupture of the cyst in which the fœtus is contained. It becomes septic, falls into the peritoneum, and sets up a severe peritonitis, ending fatally in one or two days. In other cases the fœtus in its membranes becomes infected, putrefies and suppurates with partial solution, and, if the mother does not at once succumb, adhesions and communications are formed between the fœtus and neighbouring organs, and the remains of the young animal, chiefly the bones, are expelled either directly, as by ulceration of the abdominal walls and the formation of a fistula, or indirectly, as by the intestine or vagina. If these remains are completely eliminated, the wound heals up, and the female recovers, as has been observed in sheep and goats. Most frequently, however, the mother loses condition, becomes emaciated and feeble, and perishes in a state of marasmus, or it dies from septic intoxication or septicæmia. According to Gurlt, in external ovarian gestation in the domesticated animals, the envelopes rupture towards the second or third month of the fœtal development, the fœtus falls into the abdominal cavity, constituting an abdominal gestation, and a cicatrix is left on the ovary. With regard to internal ovarian pregnancy, the ordinary termination is rupture of the organ and hæmorrhage.

Diagnosis and Treatment.—There is absolutely nothing in the early, or even in the later, stages of extra-uterine pregnancy —especially ovarian or tubal—to indicate the existence of any deviation from normal gestation; and when at length the animal exhibits indications of approaching parturition, there

may be grave doubts as to the actual state of affairs, though the absence of certain signs may give rise to suspicion. The animal is uneasy, and strains, yet the vulva is not enlarged, and the flow of mucus observed in the preliminary stage of ordinary parturition is not apparent. To be certain of the extra-uterine position of the fœtus, a vaginal examination may be made of the uterus, by which the os uteri is found not to be dilated, and the uterus empty. A rectal examination may discover the presence of a fœtus in the abdomen, but it is frequently difficult to be quite sure that the uterus is empty. Palpation of the abdomen is useful, especially in carnivora. Here the fœtus may be found fixed more or less to the abdominal wall.

In vaginal pregnancy there is, of course, an absence of the usual signs of abdominal gestation, unless this is going on concurrently. The animal shows symptoms which should lead to exploration of the vagina, when the fœtal tumour will be encountered. This will probably be attached to the floor of the passage, from which it will be easily removed. In many cases of the extra-uterine pregnancy the discovery is only made post-mortem.

If the diagnosis is well established, and the animal can be utilized for food, it is generally better to have it destroyed if in fair condition. In other cases, where the life of the animal is endangered, the removal of the fœtus may be considered. In the carnivora the removal of the fœtus is likely to be successful. The operation consists first of a laparotomy, as in Cæsarian section, and, secondly, the enucleation of the fœtus and its envelopes from their point of attachment. Where fistulæ form, they should be opened, the remains of the fœtus taken away, and the wound treated antiseptically.

Spurious or Pseudo-Pregnancy.

Spurious pregnancy is a designation applied in veterinary practice to certain accidents, characterized by the development of special pathological productions which may probably be due to a previous conception, and which more or less simulate normal pregnancy. Such cases are not common,

and the principal of them are moles, uterine cysts, and hydrometra, or hydrops uteri.

Moles, or anidian monsters, are more or less voluminous fleshy masses constituted each by a blighted embryo, the membranes of which have continued to perform their function and to nourish the abnormal growth. They are as a rule met with only in ruminants, and especially the bovine species, though Roell mentions their occurrence in the mare, and in

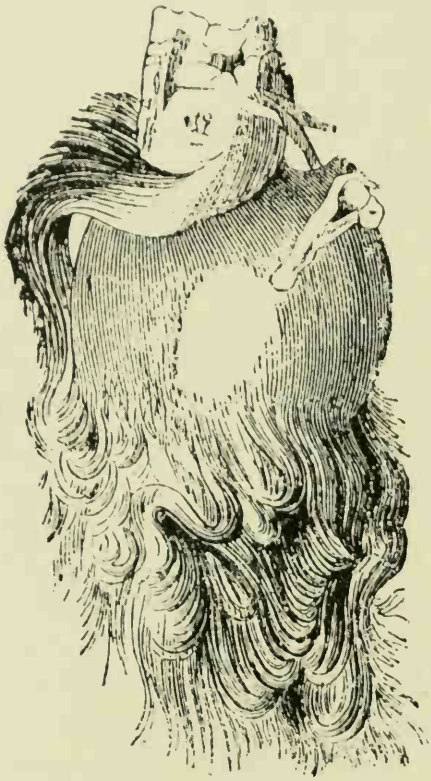

FIG. 55.—A MOLE. (ZUNDEL.)

nearly every case they appear to be one of twins, the development of which has been arrested at a certain period.

The mole (*mola cruenta*) is more particularly characterized by the persistence of an umbilical cord, which, though degenerated, yet seems in the majority of cases to maintain relations between the tumour and the uterus. In these moles the distorted remains of a fœtus may be distinguished, such as skin, bones, teeth, muscles, and even organs of special sense. Not infrequently there is a complete covering of skin and hair. Rainard and others found fibrous moles (*mola racemosa*) in the

uterine cornua of the bitch, pig, and other multiparous animals, during gestation, and most frequently in the last dilatation of one horn, rarely in both; sometimes they were placed between two of the dilatations which contained fœtuses. They were spheroidal and soft or irregular in shape, and muscle-like, and consisted of white fibrous tissue. Traces of a placenta have been found near them. These moles do not present any serious difficulty to parturition.

Uterine Cysts are pathological productions in which the placental villi are distended with fluid, enlarged, elliptical, transparent, become prominent and attached by a stalk to the uterine wall, while their vessels are obliterated and disappear. These cysts have also been called vesicular moles. Hydatid cysts have also been mentioned as occurring in the uterus of the domesticated animals, but details are wanting. They may attain an immense size and stimulate the uterus to contract.

Occasionally immense tumours develop in the uterus. These must be dealt with as they arise. They cause enlargement of the uterus, and are diagnosed by rectal and vaginal examination.

Treatment consists in dilating the os uteri and surgically removing the cyst or tumour.

Hydrops Uteri, or Hydrometra.—Hydrops uteri is a collection of fluid in the uterus, usually serous in character, sometimes glairy and mucoid. Many instances of this condition are recorded in British and foreign veterinary literature in the mare and cow, a few also in the sheep and bitch. It may result from the breaking down of a cyst or mole or injury to the uterus. The injury is frequently confined to the neck of the uterus, and is inflicted during parturition or copulation. The os becomes stenosed, and prevents the discharge of the normal glandular secretions of the uterus.

As the collection of fluid increases, the abdomen gradually enlarges, and in the early stages is difficult to differentiate from pregnancy. It is rare for this collection to persist for more than five or six months without being evacuated at least once, often every month. The fluid is sometimes serous, at others greyish-coloured, thick, fœtid, and often as much as an ordinary bucketful in amount. In one cow observed by the

editor the contents were serous, the right horn only was affected and attained the size of the rumen. There was complete occlusion of the opening of the horn into the body of the uterus. Saint-Cyr remarks that these collections form usually after what is regarded as a successful copulation. The chief danger arises from the introduction of pathogenic organisms to the uterus. Recovery has often followed the evacuation of the fluid; in some cases the condition has become so aggravated as to cause death. In a few cases the uterine walls are œdematous, and may be 5 or 6 inches thick.

The diagnosis is arrived at by manual exploration of the uterus through the rectum and vagina, thus making evident the absence of a fœtus and distension of the uterus with fluid. Another important feature to be noted is the absence of the most characteristic indications of pregnancy, such as enlargement of the mammary glands.

Treatment.—Carefully dilate the os, evacuate the uterine contents, and wash out the uterus with antiseptic fluids. Give gentle laxatives frequently, and nourishing food, with tonics (arsenic, nux vomica). Where this evacuation cannot be effected in the bitch, ovaro-hysterectomy is indicated.

Influence of Pregnancy on Ordinary Diseases.

The influence of pregnancy on the course of the ordinary diseases of animals has not yet been well ascertained, though it has long been observed that such an influence exists, and has often been productive of marked effects. It is believed that the effete products of the increased metabolism during pregnancy are not all eliminated as in health, and the retained "poisons" may cause, or predispose to, some of the diseases to which the pregnant animal is subject. These poisons are carbonic acid, urea, uric acid, hippuric acid, creatin, etc. Laulanié and Chambrelent have shown that in woman, towards the end of pregnancy, the urine loses much of its toxic power, and they conclude that these poisons, which are not eliminated by the kidneys, as in the normal state, accumulate in and saturate the system of the pregnant woman.

Probably the same condition occurs in animals, and may bear some causal relation to eclampsia and ante-partum paralysis.

The mechanical effects of the fœtus, and the immense volume of the uterus, must also produce disturbance of abdominal and thoracic organs. During pregnancy such affections as colic, tympanites, enteritis, pneumonia, are frequently followed by abortion and slow convalescence or death of the animal. The fœtus becomes such a drain upon the animal that acute diseases are more fatal during pregnancy, or often cause the death of the fœtus, and even abortion. That is frequently noted in influenza of the horse, in contagious bovine pleuro-pneumonia, foot and mouth disease and cattle plague, and sheep-pox. In foot and mouth disease abortions have resulted in as many as 50 per cent. of cases.

Chronic diseases have in general but little influence on gestation. The symptoms of broken-wind in mares are much relieved during pregnancy, but after parturition they reappear with renewed vigour. Painful and nervous diseases are also more serious during pregnancy. Osteomalacia is more common and severe in pregnant animals.

DISEASES INCIDENTAL TO PREGNANCY.

Pica, or Indigestion.—The appetite of pregnant animals, especially the cow, sometimes becomes depraved. They will ingest foreign matter, such as plaster licked from the walls, wood gnawn from their stable fittings, earth, etc.

When depending on derangement of the digestive functions, this depraved appetite may be corrected by the careful administration of tonics, antacids, and attention to the quantity and quality of the food. The herbivora should be allowed common salt and bone meal in their food or to lick.

Constipation is, of course, due to many causes, some of which have no relation to pregnancy. It is most common in bitches insufficiently exercised.

It is best remedied by a suitable diet and exercise. Purgatives should be avoided. If necessary, laxatives, such as castor-oil or cascara sagrada, may be given. Enemata are useful.

Colic.—Colic may appear in some instances, during the early months of pregnancy in the mare, the attacks being

generally slight, and occurring at intervals. It may be due to indigestion, and only requires simple treatment—friction to the abdomen, enemata of warm water, and laxative food, such as linseed mashes and warm gruel.

Œdema.—Œdema consists of an infiltration of the connective tissue of certain parts of the body with lymph. It is seen most commonly in the mare, occasionally in the cow, and is most marked in primiparæ. It is caused by defective heart action, want of exercise, and pressure exerted by the fœtus on the vessels coming from the hind-limb and pelvis. The period at which it is manifested depends much upon breed, conformation, and individual temperament. With common-bred, lymphatic mares deprived of sufficient exercise, it appears at an early period—from the eighth month of gestation, and sometimes earlier—particularly in winter. The œdema usually commences at the inferior part of the hind-limbs, gradually ascending to the hocks or higher; the fore-limbs are also attacked, though not so markedly, and the swelling extends to the lower surface of the abdomen. Here it commences as a soft tumefaction in front of the udder; this increases in size, and spreads over that gland as high as the vulva, down the inner surface of the thighs, and towards the chest, sternum, and forearms. It readily disappears or diminishes with exercise, and is not serious. Usually exercise or hand-rubbing are all that is necessary to counteract the œdema, and the disease disappears a day or two after birth. If it causes inconvenience, bandages to the limbs, and the use of laxatives, such as oil, or small doses of heart tonics, are indicated.

Hydramnios, or Hydrops Amnii—Dropsy of the Amnion and Allantois.

Hydramnios is an unusual accumulation of fluid in the amniotic as well as the allantoic cavities. Properly speaking, the term hydramnios should apply only to the amnion, but in the condition to which it refers there may also be an increase of the allantoic fluid. It has been observed chiefly in the cow and mare, but has also, but rarely, been recorded in the goat (Saint-Cyr) and in the ewe and bitch (Merrick). Gierer observes that it is most frequently met with in poor badly-fed animals, and particularly in cows under improper

hygiene. Animals that have already had several young are much more frequently affected than primiparæ.

Etiology.—The etiology is not well understood, but to it are assigned several diverse causes. Improper feeding has been noted in some cases. Williams observed the condition among Shorthorn cows impregnated by an American buffalo. It has been supposed that obstruction to the fœtal circulation, induced by torsion of the umbilical cord, or imperfection in the function of heart or liver of the fœtus, may act in producing it. But it is unlikely that the true cause will be elucidated until the method of formation of the normal allantoic and amniotic fluid is discovered.

Symptoms.—It is not until pregnancy is advanced, the fifth or sixth month in the larger animals, or even later, that indications of this condition are evident. Then the abdomen rapidly enlarges, especially to one side—generally the right in cows—and in a short time it has acquired a greater volume than it attains towards the end of normal gestation. At this period the health is deranged, and colic, with or without tympanites, is not infrequent. General debility is so marked that in severe cases the animal can scarcely, if at all, stand; the appetite is decreased, rumination in many cases suspended, thirst is marked, defæcation and micturition are irregular. Œdematous swellings of the limbs and abdomen ensue, with dyspnœa, which increases so quickly in intensity that asphyxia is often imminent. The muscular parietes of the abdomen have in some cases been ruptured, and the entire mass of the uterus, with its contents, have formed a subcutaneous hernia. The ordinary period of gestation may be completed, or abortion may occur in the later stages of pregnancy. The uterine contractions, owing to the overstretched condition of the walls, and its distended and paralyzed fibres, are weak, pains feeble and unsustained, the os does not dilate, and the act of parturition is consequently tedious.

Diagnosis.—The state of the abdomen might lead to the supposition that the case is one of tympanites, ascites, or twin-pregnancy. Abdominal percussion yields a dull sound, sometimes a splashing sound. Rectal examination (the best guide to a diagnosis) reveals the immense size of the uterus, which forms a great globular mass in the abdominal cavity,

and almost completely fills the pelvis, though nothing of a fœtus may be detected; while vaginal exploration discovers the os uteri closed, and the posterior part of the uterus projecting more or less into the vagina. Pressure on this prominent portion proves that it contains fluid, though usually no fœtus can be felt, as it is beyond the touch, and almost lost in the small ocean of fluid surrounding it. In rare cases the os is partially dilated, and the fœtal membranes protruding more or less into the vagina; usually, however, scarcely one or two fingers can be introduced into it.

Results.—The occurrence of hydrops amnii is nearly always fatal to the fœtus. The fœtus may live up to the time of parturition, but in some cases it is arrested in its development, and dies before that time. It may even be in a state of anasarca.

The mother may survive if assistance be prompt and early, but in the severe case the state of the mother is very precarious, and she often dies.

After death the uterus is found excessively dilated, its walls pale in texture, with ecchymoses on its surface. The fœtal membranes vary in density and thickness. The fluid is contained in alveoli between the amnion and allantois, as well as in these cavities. The liquor is usually limpid and transparent, of a pale citron colour, with a slightly sweetish taste. Its quantity varies from 50 to 200 litres.

Treatment.—Medicinal treatment has always proved inefficacious. The chief indication is to evacuate the fluid and cause abortion of the fœtus. The chances of success are greater if intervention takes place early, when the abdomen is not excessively distended, the respiration not seriously affected, and debility not great.

The os uteri should be forcibly and gradually dilated with the hand, the fœtal membranes ruptured, and the fluid allowed to escape. The uterus retracts, and the fœtus and membranes are sometimes expelled. Should this expulsion not take place soon, they must be removed by traction in the ordinary way. The fœtal membranes are difficult to remove in the cow, as, owing to the excessive dilatation of the uterus, they cover a large area, and are often thick and gelatinous. In urgent cases, where it is found almost impossible to dilate the

os uteri, as a temporary measure for relief of the symptoms it is recommended to puncture the uterus through the abdominal floor a little to the right of the linea alba, just behind the umbilicus, with a trocar and cannula, and remove the fluids.

Afterwards the patient should be made comfortable, given a good nourishing diet, and a course of tonics and stimulants, such as strychnine, nux vomica, ammonia compounds, caffeine, etc.

Paraplegia--Ante-Partum Paralysis.

This condition is commonly met with in the cow, has been witnessed in the sheep and goat, but is very rare in the mare. Generally it appears six, eight, ten, or twenty days, rarely a month or two, previous to parturition, and attacks animals in the most diverse hygienic conditions—those which are well fed and tended as well as those which receive the opposite treatment. It is not rare to observe in a cowshed two or three cases occurring a short distance from each other, and even in a locality we may, in certain years, meet with a number of cases; then several consecutive years may elapse without any being noted, though it would be a manifest exaggeration to say that it was either an epizoötic or enzoötic malady. It must not be confounded with parturient apoplexy.

The *Cause* is somewhat obscure. Probably it is due to compression, or rather straining, of the nerves and vessels of the posterior extremities by the heavy uterus. Debility from insufficiency or poor quality of food may induce this condition in some instances. Getting jammed when lying down, as well as slipping or falling down and injuring bones or muscles, and osteomalacia, will certainly cause paraplegia, but the large proportion of cases of ante-partum paralysis appear without such a history. In five or six cases on post-mortem inspection, infiltration and discoloration of the dorso-lumbar and gluteal muscles, a large quantity of serous fluid in the spinal canal, and injection of the spinal meninges, have been recorded. From the rapidity with which recovery generally takes place, it is obvious that the lesions cannot be serious in many cases.

Symptoms.—The paralysis of gestation generally appears

suddenly and without any premonitory symptoms, manifesting itself with the same intensity at the outset as at a later period, though in rare cases the animal shows a weakness and unsteadiness of the posterior part of the body and hind-limbs for a short time before it drops, and the end of the tail is said to be remarkably flaccid. When paralysis has really set in, the cow is forced to lie, but it does not appear to suffer; the position is natural, the head carried as usual, the eye bright and clear, the muzzle damp and cool, and rumination in the majority of instances is not suspended. The pulse, respirations, and appetite, are not altered, and sensation does not seem to be impaired, even in the hind-limbs. Constipation is frequently present. It is only when the animal attempts to rise that its condition is evident. The fore-limbs and neck can be moved to accomplish this, but the hinder extremities are powerless, or can only be raised to a slight extent, though with help the patient may be lifted up, and can then stand, but unsteadily. In attempting to form a correct diagnosis of a case, one must eliminate fractures, contusions, luxations, etc. One must roll the animal over and inspect all parts, including the pelvis by a rectal exploration. Ordinarily the paralysis persists until parturition, when it disappears. In some cases the animal is able to rise only on the second or third day after parturition. Occasionally the paralysis persists for a longer time after calving, and either causes death or necessitates slaughter. The nearer to parturition the disease appears, the better the prognosis. When the paresis appears as early as the seventh or eighth month, the prospect of recovery is not favourable. If the animal is old or debilitated, there is less hope for recovery. When it can move the hind-limbs after a day or two, and change its position from one side to another, a favourable issue may be predicted.

Treatment.—The animal must be provided with a comfortable bed to prevent bedsores, and the floor must be horizontal. The cow, if she does not do so herself, must be turned over twice or three times daily. If possible, the animal should be raised occasionally to get rid of loss of muscular power. Constipation should be prevented or relieved by the action of laxatives and laxative diet, green food, mashes, etc. If general

debility is noted, then highly nutritious food and tonics should be given. Nerve stimulants, such as strychnine or nux vomica, stimulating applications to the spine, and frequent massage of the limbs, are indicated, if the cow does not rise shortly after parturition. Should paralysis persist, and the time for parturition be some months distant, abortion should be induced. Under aseptic conditions, the os uteri should be gradually dilated, the fœtal membranes ruptured, and the fœtus removed. This may be effected in a few hours. If necessary, the fœtal membranes may be removed by hand in eighteen to twenty-four hours afterwards.

Cramp, a tonic, involuntary, and extremely painful contraction of one or more voluntary muscles, is sometimes observed in the mare and cow during the second half of gestation, the muscles of the thigh, and chiefly the principal extensor of the metatarsus, being almost exclusively involved. It is of little importance, and can be relieved by walking the animal for a few paces or by smart friction. It disappears altogether after parturition.

Eclampsia, hysteria, parturient apoplexy, and *mammitis*, have also been recorded occasionally in animals before parturition. Their symptoms and treatment do not differ from the ordinary type of such affections.

Amaurosis has been recorded in two pregnant mares by Riss. The animals recovered their power of vision shortly after parturition.

A *Cough* is sometimes noted in pregnant animals, but disappears after parturition. It is thought to be due to pressure by the enlarged uterus on the diaphragm.

Albuminuria is given by Zundel as one of the complications or accompaniments of gestation in animals, though he does not look upon it as a pathological condition.

Pregnancy Disease or Toxæmia in Ewes.—In recent years fatalities have been observed in ewes during the last few weeks of pregnancy. Sometimes several ewes have died in a flock from this cause. The symptoms shown consist of dullness, separation from the flock, inappetence, staggering gait, and death within a few days. Usually there is more than one lamb in the uterus

The only marked lesion noted is extreme fatty infiltration of the liver, but there may also be found patches of congestion of the mucous membranes of the intestines.

This has been thought to be due to concentrated diet, but it has been seen in ewes at grass receiving no concentrates. A reduction in diet and forced exercise have been recommended for the prevention of this condition.

ACCIDENTS OF PREGNANCY.

Ante-Partum Prolapsus of the Vagina.

Prolapsus vaginæ, or inversio vaginæ, has been observed during pregnancy most frequently in the cow and sheep, rarely in the mare and bitch. It consists in the protrusion, or pushing backwards, of the vagina by the uterus and its contents, the tumour it forms appearing between (inversio vaginæ incompleta), or external to (inversio vaginæ completa), the labia of the vulva.

This accident may occur in well-shaped cows whose tissues, and especially those of the genital organs, are soft and relaxed —animals of a lymphatic temperament, good milkers, with wide pelvis, and which are fed on an abundance of bulky, but innutritious, food. Keeping such cows on a floor sloping too much to the rear, as well as falls, injuries of different kinds, distension of the rumen, fatigue, etc., are all likely to lead to this accident in those animals, when pregnant. Probably an infection of the vaginal mucous membrane takes place, which causes irritation and consequent straining and prolapse. The condition is observed, though very rarely, in primiparæ, and occurs most frequently after the third or fourth gestation. It occurs oftenest at the end of the seventh or eighth month of pregnancy, but has been met with as early as the fifth month, and as late as twenty or fifteen days before delivery.

Symptoms.—At the vulva there appears a circular, bright red, sausage-like tumour, depressed in the centre, and of a variable but gradually increasing size as gestation advances, or the exciting causes remain in operation—from the volume of a fist to that of the head of a man, or even larger. At

first it is only visible when the animal is lying, and disappears when it gets up; but when of considerable volume it never entirely vanishes in the latter attitude, and even when the prolapse is reduced by the hand the vulva remains larger than usual.

If it persists for some time, in certain cases inflammation and infiltration take place, when a large and somewhat dense tumour projects permanently outside the vulva, the circumference of the latter constricting it and rendering matters worse. The colour now becomes a darker red, and even dark brown; the tumour may be abraded on the surface from the rubbing of the tail and contact with the fæces and urine, while at its upper part can be seen the neck of the uterus. The animal does not seem to be incommoded, unless it be of an irritable disposition, when straining may take place; and this increasing in intensity, the cervix, and even a portion of the body of the uterus, will follow the everted vagina, and a spontaneous reduction can no longer take place, while manipulation increases the straining. This is, in reality, now a case of prolapsus uteri, and an examination of the voluminous mass may lead to the detection of some portion of the fœtus in its midst. Displacement of the bladder may ensue, and when this is distended with urine it will render reduction more difficult.

Sheep, when heavy in lamb, frequently evert a double fold of the vaginal mucous membrane. This happens when they are in a recumbent position, and it is in some animals of such frequent occurrence as to cause excoriation and ulceration.

In the majority of cases this prolapse does not appear to cause the slightest inconvenience to the animal, and offers no obstacle to parturition; indeed, it has been noted that such cows calve more easily than others. Neither does it predispose to chronic eversion of the vagina. After calving, the prolapse disappears spontaneously.

Treatment.—Where treatment is necessary, the floor of the stall must be levelled or raised a little behind by means of litter. The diet must be laxative, and not too bulky, to avoid straining. When heavy feeding is suspected as the cause, a purgative should be administered to unload the alimentary canal. That may be all that is necessary to do in mild cases.

In serious cases, when the tumour is large and the cow strains, and spontaneous reduction does not occur in the standing position, the mass must be returned. This is readily enough accomplished, but it sometimes happens that reduction does not prevent a continuation of the straining, and the everted vagina again appears.

The vagina must be maintained in position, and the straining, which is due to irritation or infection or pain, must be overcome.

The prolapsed organ must first be cleansed well with tepid water or a non-irritant antiseptic lotion, such as 1 per cent. lysol. If the organ is painful and irritable, cocaine or other local anæsthetic should be applied, and a little adrenalin added to relieve the congestion. De Bruin recommends a warm 2 per cent. alum solution. It may be necessary also to remove the urine by catheter.

During the process of reduction the animal should be kept in the standing position, preferably with the hind-limbs higher than the fore. The hind-limbs of the smaller patients should be lifted up with the hands, and then the prolapse may be reduced spontaneously or with slight pressure. In the cow, gentle and careful pressure with the palm of the hands should be brought to bear on the tumour until it has retreated within the vulva. Then the hand should be introduced into the vagina to smooth out this tube into its natural position. To prevent straining during the process, the loins should be pressed in a forcible manner by means of the hand of an assistant, or a stick placed transversely, a man at each end. Suppositories of lard or vaselin, containing such agents as iodoform, tannin, or other local anæsthetics and antiseptics, may then be introduced to relieve the irritation and infection of the vaginal mucous membrane, and thus prevent straining. The fatty or oily dressings applied to the vagina keep the mucous membrane soft.

If the patient continues to strain after reduction of the prolapse, a sedative, such as chloral hydrate, opium, etc., should be administered, and attempts made to prevent the reappearance of the prolapse. A girth or surcingle tied tightly round the back reduces straining. A well-adjusted truss such as described later for prolapse of the uterus is very useful, but can only be applied for a short time.

Sutures of copper wire, or tape, inserted through the lips of the vulva or the skin at the side of the tuber ischii across the vulval openings, have proved very efficacious. The chief danger arising from these sutures is that they may be torn out by the straining of the animal, and the prolapse recur. The tape or wire must be strong and thick, and if passed through the walls of the vulva must be inserted 1½ to 2½ inches from the lips. Two or three sutures are sufficient. Pieces of india-rubber tubing inserted by means of a seton needle make excellent sutures for the purpose, and may remain in position for months without tearing (Van Leeuwen). A West's clamp is very serviceable, but it is difficult to obtain a good grip of the lips of the vulva, and the clamp is frequently rubbed or forced off. With sheep, it is a common custom to prevent a recurrence of the prolapse by tying the wool across the vulva or applying a small West's clamp.

Where the prolapse is very severe, and it is found almost impossible to abolish it altogether, artificial delivery should be effected without delay. More especially is this to be adopted when pregnancy has reached the 260th day in the cow, and the calf is alive. Perforation of the membranes may be effected by the fingers after they have dilated the os. There is no difficulty in parturition as a rule, but care is necessary for some days afterwards to prevent inversion of the vagina or uterus.

Hernia of the Uterus (Hysterocele).

Hernia of the uterus is not uncommon in the domesticated animals. In the bitch the organ is often displaced before conception, and the fœtus is developed in the hernia; but with the larger creatures the empty uterus is too far removed from the abdominal parietes to escape from the cavity, and it is only when its volume is increased, as gestation advances, that it may form a hernia, should there exist an accidental opening in the muscles which enclose the abdomen.

In the bitch the hernia may be inguinal; in the other animals it is always accidental and ventral, and usually towards the inferior part of the abdomen on the right or left side, or in the pubic region. Its ordinary cause when accidental is the natural or spontaneous relaxation of the

abdominal aponeuroses, or traumatism, as contusions or strains, the viscus being generally only covered by the skin. It is rare in young animals.

In the cow, it is not at all unusual to observe the hernial tumour in front of the pubis, towards the attachment of the rectus muscle, and near the udder; here it may be of great size, extending as low as the hocks, pushing the mammary gland to one side, reaching as far forwards as the asternal ribs, and containing, in addition, other of the abdominal viscera than the uterus and its contents. The tumour impedes movement, the hind-limbs are kept widely separated, and the animal is much inconvenienced.

With the bitch, hysterocele has been noted in two regions: above the mammæ, where it may be mistaken for a neoplasm; and in one of the labia of the vulva, beneath the skin. In the larger animals, the fœtus may sometimes be felt in the hernia, and its movements may be noticed, though, owing to its being so low, it cannot be reached from the rectum.

Very often, excepting the inconvenience to the female, hysterocele does not interfere with gestation nor give rise to any serious symptoms; though, in some instances, it may render parturition laborious and protracted, if not impossible. In other cases this act may be accomplished without difficulty or extraneous aid. Cows which have been ruptured from the pubis to the ribs have calved easily enough, and Leconte alludes to a mare, with a very extensive uterine hernia which brought forth four living foals in succession. Nevertheless, it is somewhat of a risk to attempt to breed from such animals. When treating of difficult parturition, we shall have occasion to return to this subject. In order to obviate serious consequences, the hernia should be supported by a wide bandage until the uterine contents are expelled. Should circumstances render it necessary, abortion may be artificially produced or hysterotomy performed.

Ante-Partum Rupture of the Uterus.

Rupture of the uterus may happen before and during parturition, or in attempts to reduce the organ when inversion has occurred during that act. The accident has been observed

in the cow, sheep, goat, and bitch; it is not very common before gestation has terminated, and the symptoms by which it can be diagnosed are not very reliable. Spontaneous rupture of the uterus usually occurs at the anterior part of the organ, between the two cornua, or even in the cornua themselves, the direction of the rupture generally depending on the direction of the muscular fibres, being sometimes diagonal, at other times transverse, and more rarely longitudinal. The size of the rupture also varies considerably, and the lips of the wound are either thin and ragged or swollen and inflamed. The blood effused into the abdominal cavity may be in large quantity or scarcely noticeable. The condition of the uterus varies with the cause of the rupture. In slight cases the rupture involves only the mucous and muscular coats, and the peritoneum is intact, whereas in severe cases the cavity of the uterus communicates freely with that of the abdomen.

Saint-Cyr refers to a rare condition called semimobile uterus. Here the uterus has been divided completely across, either at the body or cornua, and remains floating in the abdominal cavity, being only suspended by the broad ligaments. The fœtus and its membranes do not escape, the wound cicatrizes, and the organ appears as a large cystoid tumour. Four instances of this kind are recorded by Ercolani, of Bologna University—two in a cow, one in a sheep, and one in a guinea-pig.

Causes.—Thinning of the uterine walls, hydramnios, and distension by the gas evolved from a putrefying fœtus, contusions of different kinds to the exterior of the abdomen, and energetic contractions of the muscular coat of the uterus, may all give rise to this accident.

Symptoms.—The symptoms of rupture of the uterus are not well defined.

If the accident is due to external violence, the signs will be in accordance with its severity. After showing symptoms of colic for a short time, the animal appears to be well until parturition, when, after manifesting signs of that act, the straining disappears, and, if infection result, peritonitis sets in. Examination of the abdomen will detect the presence of fluid in its lower third, while vaginal exploration may

reveal an empty uterus, or only a portion of the fœtus in it; the rupture itself may be discovered. If the rupture has only ensued when parturition is advanced, the fœtus may be expelled in the usual way, and the symptoms only recognized when the birth has been accomplished. If it results during torsion of the uterus, the hand cannot explore the cavity; the vaginal walls become relaxed, but the diagnosis may be made by rectal examination. Later every indication of pregnancy disappears, except the enlarged abdomen, on the floor of which the fœtus lies, and its fate is similar to that described for extra-uterine pregnancy. If hæmorrhage is profuse, symptoms attributable to internal hæmorrhage may be noted, and the animal dies.

Treatment.—But little can be said as to this. The animal dies often without a definite diagnosis being made. If pregnancy is complete and the fœtus alive, hysterectomy or hysterotomy may be adopted to save the fœtus in the larger animals, and both fœtus and mother in the smaller animals.

Metrorrhagia—Hæmorrhage from the Uterus.

Accidental hæmorrhage from the uterus during pregnancy is somewhat rare in animals. Cases have been recorded—in the cow, by Carsten Harms, Egli, Anacker; in the mare, by Zundel, Schmidt, Macgillivray, Kotelmann, Vogel; and in the cat, by Violet.

In the majority of cases it is occasioned by a spontaneous separation—more or less extensive—of the placental capillaries from the uterine surface. Sometimes there is a history of an accident. Zundel has seen it occur in an animal which showed signs of œstrum while pregnant.

Symptoms consist in a discharge of blood from the vagina, particularly during micturition. In some cases the blood remains in the uterus, and may amount to 4 gallons in the large animals. In severe cases symptoms of internal hæmorrhage appear—pallid mucous membranes, running-down pulse, cold extremities, gradually increasing weakness—and the animal dies in a short time. Less acute cases result in the death of the fœtus. In some instances the hæmorrhage is slight and soon ceases, and the fœtus is born alive and healthy.

Treatment.—When there is no escape of blood externally, the diagnosis of this accident is most difficult; but when hæmorrhage is apparent, the animal must be kept quiet, ice-bags be applied to the loins, and internally hæmostatics, such as adrenalin chloride hypodermically, ergot or hydrastis canadensis administered. If that is not successful, artificial delivery should be attempted, and the same treatment adopted as for post-partum hæmorrhage (which see).

Abnormal Retention of the Fœtus.

Cases of abnormal retention of the fœtus have been observed in all the domesticated animals, but most commonly in the cow. Saint-Cyr records thirty-five instances in the cow, seven in the ewe, five in the mare, and only one in the bitch. The length of time during which a fœtus may be retained beyond the normal period varies from a few months to five years.

The *Causes* assigned for this condition are those which prevent normal parturition—a diminution or loss of contractile power in the uterus itself to expel its contents, and the absence of assistance when attempts are made; adhesions of an unusual character between the uterus and the placenta; malposition of the fœtus; deformed pelvis; fibrous induration or spasmodic contraction of the cervix uteri; torsion of the uterus, or adhesion of its ligaments. Hæmorrhage into the cotyledons has sometimes been responsible for death of the fœtus in the heifer. Afterwards the fœtal fluids are absorbed and the fœtus undergoes desiccation. This may occur at any time during pregnancy—*e.g.*, at three, four, five, or more months. The fœtus is retained indefinitely, probably on account of the persistence of the corpus luteum.

Symptoms and Termination.—The symptoms at first are, of course, those of pregnancy until the period of normal parturition. At this latter period or earlier there are nearly all the signs of parturition, but the os remains closed and no fœtus appears. These signs may be only slightly marked, or may continue for a day or two. Then they disappear, and, if in a cow, the secretion of milk goes on as before. If the fœtal membranes are not ruptured, the health may never be

impaired, and the retained fœtus not suspected until, if a cow or a sheep, the animal is slaughtered for food, and a post-mortem examination made. Exceptionally only does œstrus appear, as Rossignol describes in a cow with a fœtus retained for twenty-seven months. The animal remains sterile. The fœtus may live for a certain time after the normal period *provided the fœtal membranes are not ruptured*, and even increase in size. Cases of the kind have been noted up to 300 days in the cow, and in two cases 365 days. Most commonly the fœtus dies at or near the time of first symptoms of parturition. Then, if the os uteri remains closed, the fœtus does not putrefy; it becomes mummified. Its fluids and the allantoic and amniotic fluids are absorbed, the skin becomes dry and hard, even wrinkled, and the flesh and organs are pale and bloodless, and emit a kind of rancid odour. When the retention has continued for a long time, all the soft textures of the fœtus disappear, and nothing remains but the bones; in other instances lime salt becomes deposited in the soft tissues, and a lithopædion is formed.

In some animals the signs of parturition are again manifested, and delivery is effected usually only when assistance is given. Sometimes, if delivery is not brought about, after fruitless straining the animal continues unwell, has little or no appetite, becomes debilitated, falls into a state of marasmus, and dies after a more or less prolonged state of misery. When, at the usual time of parturition, the straining of the animal has ruptured the fœtal membranes, and the liquor amnii escapes, the case is in nearly every instance serious. The fœtus soon perishes, becomes infected, begins to putrefy, and in a short time the decomposing mass causes inflammation of the uterus (metritis). Horribly fœtid discharges are passed *per vaginam*, containing pus, decomposing tissues, even the bones of the fœtus. There is frequent and severe straining, the animal rapidly loses condition, is fevered, and succumbs more or less rapidly to the metritis and septic infection. Not uncommonly the disease lasts for some time, and emaciation becomes extreme before death ensues. Occasionally with the cow a vaginal discharge results from the presence of a putrefying fœtus, without any other serious symptom, for a long time. Figuier removed the entire skeleton of a fœtus

which had been retained for more than five years, and the cow recovered. Similar cases in which the retention lasted from three months to two years have been described by Thierry, Gervy, and in the *Veterinarian*. In the mare, however, death is the usual termination of this accident. In this animal retention has lasted up to seventeen and twenty-two months (Hamon and Hammond).

Olver describes a case in a mare which was served on June 21, 1908, and was delivered of the remains of a dead fœtus on December 31, 1910.

At a post-mortem examination of a retained putrefying fœtus, the uterus shows evidence of a chronic metritis; its walls may contain abscesses, or it has become adherent to other organs—*e.g.*, the intestines—or to the abdominal wall, with which it has established fistulous communication, and through which, portions of the fœtus may be passed. The fœtus is more or less disorganized, the bones alone may be identified, and the soft tissues have been converted into a grey or greyish-red stinking fluid.

Treatment.—When the fœtus undergoes mummification, the condition is often not suspected during life. If symptoms of parturition appear early in pregnancy, then it should be treated as if to prevent abortion, by keeping the animal quiet and administering such drugs as opium or chloral hydrate to act as sedatives and prevent straining. The mummified fœtus is occasionally discovered on a rectal examination made to ascertain the cause of sterility; in that case in the heifer or cow the corpus luteum should be enucleated from the ovary by manipulation per rectum or per vaginam, or if necessary after a laparotomy. This enucleation will be followed by expulsion of the fœtus in a few days.

Where serious symptoms appear, artificial delivery of the fœtus is imperative. Especially is this the case when the fœtal membranes have ruptured and the fœtus is undergoing putrefaction. The method to be adopted will depend on the causes of the retention, to be referred to later. The os must be carefully dilated, a twist of the uterus set right if present, and the fœtus removed by hand. Embryotomy may be necessary where there is a malpresentation or the fœtus too large or emphysematous. After removal of the fœtus, the uterus

must be washed out with sterile water or mild antiseptic fluid, such as potassium permanganate (1 in 1,000), and all the discharges and fluids siphoned off. General treatment may also be required.

ABORTION.

Abortion consists in the expulsion of the embryo or the fœtus at a stage when this has not attained sufficient development to live external to its parent. The young creature is either dead when expelled from the uterus, or dies immediately afterwards. When the fœtus is expelled before the ordinary period of parturition, yet with all its organs sufficiently perfected to enable it to exist for at least some time in the external world, this is designated premature birth. Then the fœtus may be weakly and immature, and succumb after a variable period, or it may continue to live and thrive. In practice there is no accurately defined limit between abortion and premature birth, especially when the latter has been brought about by some of the causes which produce the former.

Abortion may be said to take place in solipeds when the fœtus is expelled at least forty days before the normal period ; in the bovine species, thirty-five days ; in the sheep and goat, twenty days; in the pig, fifteen days; and in the bitch and cat, seven days. According to Saint-Cyr, abortion is the expulsion of the fœtus before the 300th day of gestation in the mare, before the 200th in the cow, before the 140th in the ewe, and before the 100th in the sow.

The frequency of this accident is greatest in the cow. It is also common in the mare, and not at all rare in the sheep and goat. The bitch and cat rarely abort, even after serious injuries, and the sow retains its fœtuses almost as tenaciously. No estimate can be given from statistics as to the relative proportion of abortions in the various species.

Abortion may occur at any period of gestation within the limits above named, though it is perhaps more frequent during the first than the second half of pregnancy, and especially with the mare.

Abortions may be classified as (1) sporadic, (2) enzoötic, epizoötic, or contagious.

1. Sporadic Abortion.

Sporadic abortion occurs usually in isolated instances, and is due to a variety of causes. In many of the cases formerly described under the heading of sporadic abortion it is difficult to understand the relationship between the assigned or alleged causes and the effect, and it is probable, in the light of our present knowledge, that many of these cases were really cases of contagious abortion. It is not to be supposed from this that sporadic abortion does not occur, but, rather, that it occurs less frequently than was formerly believed.

Atmospheric influences, cold or inclement weather, or irregular seasons, have been cited as predisposing to or causing abortion. We know that these can seldom act in the lower animals, because pregnant ewes, cows, and mares, are exposed to all kinds of weather without any untoward symptoms.

Defects in the foodstuffs have also been regarded as causal agents. It may be said generally that food of bad quality, indigestible and containing injurious ingredients, is dangerous alike to mother and fœtus; but very serious symptoms are shown by the pregnant animal before abortion occurs. Indigestible food, which tends to cause impaction or tympany, may produce this accident by exerting pressure on the uterus. Rue, savin, ergot of rye and other ecbolics, cantharides, digitalis, either administered accidentally or taken up in the fodder, will of course have a tendency to cause expulsion of the fœtus more or less readily. Ergot of rye does not appear to be so certain an ecbolic in herbivorous as in carnivorous animals, large quantities of it having been given to pregnant cows without abortion resulting. It has also been noted that in some pastures, where ergotized grasses may easily be found, abortion in cows or sheep has not been recognized. It may be that the animals naturally avoid the contaminated grasses.

To the use of drinking water contaminated with sewage have been attributed various outbreaks of abortion, especially in cattle, but in none of the recorded cases has contagious abortion been excluded.

Drastic purgatives are dangerous drugs to administer during pregnancy. In inducing increased peristalsis they may also bring about active contraction of the uterus and expulsion of the fœtus. Harms has, however, frequently administered aloes to pregnant mares without observing ill effects.

Excessive muscular exertion and unusual travelling are very likely to produce abortion; if the exertion is sudden and severe, coming after a long rest, it is all the more certain Contusions to the abdomen by kicks or falls, or squeezing through a narrow doorway or passage, railway or steamboat travelling, blows and shocks, keeping the animals in stalls with very inclined floors, and so rendering them liable to slips and falls, are all so many causes. Mechanical injuries more commonly produce such effects in the larger animals than in the bitch and cat. Access of the male not infrequently produces a miscarriage; and exploration *per vaginam*, even by the expert, has also been blamed, as well as serious surgical operations performed on pregnant animals—*e.g.*, when there is severe hæmorrhage—or throwing an animal down to be operated on.

Carrying a rider in the case of the mare, and especially if spurs are used, is attended with much risk.

Excitement, fear, sudden surprise, or anger, are also occasional causes. Sheep chased by dogs or frightened by packs of hounds sometimes abort. After such accidents as the above, abortion, when it occurs, generally takes place within a few days.

It is generally admitted that with some animals there is a special predisposition to abort, even though the cause is a trifling one or hardly appreciable. Sometimes it disappears as age advances. It may be due to some defect of the genital apparatus.

A more potent cause, however, is the presence of grave diseases, producing more or less derangement of functions. Abortion has been frequently noted in the course of epizoötic diseases, such as foot and mouth disease, contagious bovine pleuropneumonia, influenza, sheep-pox; also in tuberculosis where the uterus is extensively involved, in acute abdominal and pulmonary disorders, and even in epilepsy and anæmia. Occasionally sporadic abortion is due to some infection of the

uterus, and in the cow such organisms as the *Bacillus pyogenes*, a spirillum, *Bacillus coli*, or a bacillus of the colon-typhoid group have been recovered from the membranes, uterine discharge, or fœtus in isolated cases of abortion.

Hydrocephalus, ascites, anasarca, may also lead to death of the fœtus, and death of the fœtus from any cause is usually followed by its expulsion. Diseases of the fœtus and its envelopes, such as hydramnios or faulty attachments of the membranes, are also causes. In the mare, twin pregnancy is often followed by abortion.

Diseases of the uterus or genital organs, metritis, new growths, will also lead to premature expulsion of the embryo or fœtus.

Symptoms.—When abortion occurs at a very early stage, it may produce no appreciable disturbance of health in the female, and the embryo escapes intact and often unperceived. The accident is more serious when it happens at a late period, as it then not only causes the loss of the young animal, but may compromise the existence or value of the mother.

Generally abortion takes place without any premonitory indications, and the animal may be as well and lively as usual up to the moment when the fœtus is expelled; and the expulsion itself is so sudden, so prompt, and accomplished with so little visible effort or disturbance, that the accident in most cases receives very little, if any, notice. It frequently occurs during the night, and the aborted fœtus—generally contained in its intact envelopes—is found lying behind the animal in the morning.

The mother shows the utmost indifference to the fœtus, even treading on it. If the abortion is seen, it may be noted that the flanks fall in a little, the abdomen descends, the vulva and vagina slightly dilate, and there escapes from them a glutinous, sometimes sanguinolent, fluid, with which the fœtus escapes almost without effort. In the later stages of pregnancy, after about the seventh month in the mare and cow, the symptoms preceding abortion more closely resemble those of parturition, and the fœtal membranes rupture before the fœtus is expelled. In many instances the fœtal membranes are retained in the uterus.

In abortion due to injuries, the precursory symptoms

are generally well marked. The animal suddenly appears dull and peculiarly dejected, especially if the fœtus is dead; or it is restless, uneasy, and continually moving about. If pregnancy is advanced, and the fœtus alive and strong, its movements are, on watching the abdomen attentively, perceived to be frequent, violent, and disordered; but they soon become feeble and infrequent, and cease altogether when the fœtus has succumbed. The appetite is lost; a plaintive neigh in the mare, moan in the cow, or bleat in the sheep, is emitted every now and again; the pulse is quick, small, and hard, and the respirations hurried; progression is difficult and unsteady; the physiognomy anxious. The animal—particularly the mare—often looks anxiously towards the flanks, paws with its fore-feet and stamps with its hind ones, moves from side to side, breaks out into patchy sweats, lies down and gets up again, whisks the tail incessantly, and exhibits every indication of increasing restlessness. At the same time the abdomen loses its round shape and drops; if the animal is in milk, the mammæ become soft, and diminish in size more or less rapidly, while the secretion diminishes; but if it is not yielding milk, then, on the contrary, they enlarge and become turgid; the vulva is tumefied, and from it escapes a tenacious mucous, serous, or sero-sanguinolent fluid, which may be more or less fœtid if the fœtus is dead and putrefying. Then follow symptoms analogous to those which characterize normal parturition—the uterus begins to contract, and the expiratory muscles act simultaneously with it; the expulsive efforts, or "labour pains," acting more or less energetically and continuously, according to the suddenness of the abortion and the strength and health of the animal. The straining causes, first, evacuation of the bladder and rectum; next, dilatation of the os uteri, and protrusion of the membranes into the vagina, then through the vulva, where they appear externally as the "water-bag." This may rupture, and the liquor amnii escape; and the pains becoming more powerful, the fœtus is at last expelled either nude or covered by the membranes. This act occupies a variable period, according to the strength of the animal; and it may occasionally require assistance to remove the fœtus. In a few cases the fœtus is not expelled immediately after it dies;

the mother regains its ordinary tranquillity, appetite, and liveliness, and the symptoms disappear for one or more days, when they again set in, and the fœtus is then rejected.

In the case of two or more fœtuses, it may happen that the one or two nearest the os are dead, and are expelled; the others, being alive, are retained until pregnancy is complete, or, in multiparous animals, expelled with the dead fœtuses. Or the contrary may occur: the living fœtuses, being nearest the os, prevent the escape of the dead ones until normal parturition. In the meantime the dead fœtuses undergo mummification. Occasionally in sudden abortion preparation is not made for rejection of the fœtus, and unless assistance is given the mother is soon exhausted by its ineffectual efforts, and passes into a critical condition.

Abortion differs from normal parturition chiefly in the state of the cervix uteri. The cervix is long and rigid, as in the non-pregnant condition, and its dilatation is therefore slower, more difficult, and more incomplete, especially as the muscular fibres of the uterus have not acquired their full development; but to counterbalance this the fœtus is small and more easily passed.

Results.—Abortion is always a serious accident, if only from the loss of the fœtus. It is sometimes complicated with hæmorrhage, which may primarily have been the cause of uterine action; it may also result in rupture of the organ from the efforts the animal makes to overcome the resistance offered by the cervix; indeed, we have the usual complications that attend parturition. But very frequently the complications are few and trifling.

When the accident occurs in the cow at an early period—before the fifth month—the secretion of milk is generally interrupted, often for a year, as the mammæ have not had time to experience the influence which stimulates them to activity; when, however, it takes place in the latter half of pregnancy, the secretion may be established, though the yield is usually diminished, and the glands do not furnish their ordinary quantity till the next pregnancy. Abortion is occasionally followed by prolapse of the uterus and vagina, rarely of the rectum.

When abortion occurs in the later stages of pregnancy,

retention of the fœtal membranes is a very common sequel, owing to the rapid contraction of the cervix uteri and the strong attachment of the membranes to the uterus. The membranes decompose and give rise to a putrid metritis.

In the simplest cases œstrus appears in the cow in from one to two weeks after the miscarriage, as after parturition, and conception may then take place. Not infrequently impregnation does not occur until after several returns of this condition, and often a whole year elapses. In other instances œstrus does not appear until the full interval of regular pregnancy has elapsed, and then the animal conceives almost as readily as before the mishap. The generative functions are frequently disturbed, and this disturbance may lead to nymphomania or a tendency to subsequent abortions.

Pathological Anatomy.—The lesions occasioned by abortion are varied according to circumstances. Especially in advanced pregnancy, the maternal organs are in a similar condition to that observed after normal parturition. The os is dilated or contracted, but in general the cervix is a little softer than in the unimpregnated state. The uterus is more or less contracted on itself, and looks congested, its vessels being voluminous and distended with blood; its cavity contains a certain quantity of blood-coloured mucus, and often all the characteristic indications of placental retention and decomposition; its mucous membrane is red and thickened, and there may be traces of inflammation in it and the cotyledons, as well as evidence of the cause which produced the accident, if due to injury. The appearance of the fœtus varies also, according to the period at which it is expelled, the cause or causes which led to its expulsion or death, as well as the period of its decease. If it has perished recently, it is little, if at all, altered; its skin is firm, white, elastic, and even; the mucous membranes are pale, and its flesh white, rather soft or firm, and odourless. If it has died some time previous to abortion, and air has been admitted to the uterus, then there are indications of putrefaction, varying in extent directly with the length of the interval between death and abortion. The fœtus is swollen, infiltrated, and emphysematous, and exhales a putrescent odour, while the hairs, and even the hoofs, are easily removed. When the air has not entered the

uterus, the fœtus may present a withered, wrinkled, and mummified appearance. If abortion has been due to hydramnios, then the fœtus is sodden and wasted.

The fœtal membranes and fluids vary in appearance. In some cases the fœtal membranes are intensely congested, in other instances they are softened, fragile, and colourless; while the fœtal fluids may be reddish-tinted or turbid, whitish, and increased in consistence.

Diagnosis.—No one can definitely foretell that abortion will take place in a pregnant animal, but the possibility of it may occasionally be considered if the animal has previously aborted without any marked cause, or has been subjected to one or other of the agents which have already been mentioned as capable of compromising the issue of pregnancy.

The premonitory symptoms are not always characteristic, and at this stage, unless the signs indicative of parturition are present, it may not be possible to give an opinion as to whether abortion is impending. In any case the genital organs, such as the vulva and mammæ, should be examined.

That abortion has taken place, the fœtus or its envelopes are the best evidence. If in the early stages of pregnancy abortion has occurred, and the embryo is not found, the first indication is frequently the return of œstrus.

In the later stages one must make an examination at least within a fortnight after the event, or the symptoms may have disappeared (Saint-Cyr). These signs comprise hard, painful, and enlarged mammæ, often yielding a small quantity of milk (that is of service chiefly in a primipara); the hair of the tail soiled and matted by blood, mucus, and liquor amnii; swollen and dilated vulva, with its mucous membrane reddened, and even showing ecchymoses, as the result of the passage of the fœtus; and on vaginal examination a dilated os, a cervix softer than usual, and a quantity of blood-stained fluid or remains of the membranes in the uterus. These signs collectively are conclusive with regard to a recent expulsion of the fœtus. In the bovine abortion should only be diagnosed as sporadic when contagious abortion has been negatived by testing the animal's blood-serum.

Treatment—(*a*) *Preventive.*—Avoid the causes of sporadic abortion already noted, and attend to the general hygiene.

Animals predisposed to abortion should, if possible, not be bred from, or, if breeding is intended, should be put to the male only after an interval of about eighteen months. If due to metritis, that should receive appropriate treatment. If there is chronic disease of the ovaries or other genital organs, the animal should not again be bred from.

When abortion appears to be imminent, an attempt should be made to avert it. If the membranes are not ruptured, the fœtus alive, and the labour pains few and not severe, the accident may be checked by keeping the animal in the most perfect quiet possible, alone in a darkened place, with doors and windows closed, if convenient, and by the administration of narcotics. The narcotics used are opium, chloral hydrate, or chloroform (in 3-drachm doses, to the cow in a draught of oil or mucilage, and repeated every hour [Zundel]) ; also camphor, or camphor and opium or asafœtida. The abdomen should be gently rubbed for some time, the animal made comfortable, and given easily digested food, gruel, and chilled water, for a few days.

(*b*) *Remedial.*—In most cases it is impossible to prevent abortion once well-marked symptoms appear. When the fœtal membranes are ruptured and the "waters" escape, the expulsion of the fœtus should be effected as speedily as possible, and the envelopes removed. Generally no assistance is required for the removal of the fœtus. Where there is any difficulty, the same procedure must be adopted as for ordinary parturition. If the cervix is contracted, then the os must be dilated, as in spasm of the os.

If the membranes come away with the fœtus, there is little more to be done. Frequently, however, the fœtal membranes are strongly adherent to the uterus, and are retained. In such cases in the cow, because the os closes quickly after abortion, the membranes should be removed by hand within three days.

The animal after abortion should be kept clean, fed on gruel and easily digested food, though not in excess, and be kept from draughts, particularly in cold weather, for some days. It should not be allowed to become impregnated at the next œstrus.

Relaxation of the genital passages in the bitch generally

follows immersion in a warm bath (112° or 114° F.) for a few minutes; it must not be prolonged after the respiration becomes hurried or the animal looks distressed, and the patient should be well dried and kept comfortable.

Any other complications which sometimes accompany this accident will be referred to in connection with ordinary parturition.

2. Enzoötic, Epizoötic, or Contagious Abortion.

Contagious abortion is most frequently observed in the cow, is seen sometimes in the mare, and less commonly in ewes and sows. Epizoötics of abortion have been recorded from the earliest times, but it has been shown only in the last few decades that the abortions were of a contagious nature. Prior to this widespread abortion was ascribed to various causes, including irritation. As we now know, there is scarcely a country in which there are competent observers that has not been reported as suffering from visitations of contagious or epizoötic abortion. Some of the outbreaks have been most destructive. In the United States of America contagious abortion among mares has proved a veritable scourge. It is stated that in 1889 and 1890, in the Mississippi valley, 75 per cent. of the mares aborted in some regions and 50 per cent. in others; and in Kentucky, in 1892, 75 per cent. of the brood mares, trotting and thoroughbred, were either barren or had lost their foals that spring. In 1891 the disease was observed in South America, in the State of Buenos Ayres, Argentine Republic, where the outbreak was described as the most extensive of any that had nitherto been observed in any part of the world.

It is very probable that there is a separate form of contagious abortion for each species of domestic mammal; but it is among cattle that the disease has received most attention.

Contagious Abortion in Cows—Abortion Disease of Cattle, or Bang's Disease.

Contagious abortion in cattle is almost, if not quite, world-wide in its distribution, and is most prevalent in countries where cattle rearing is highly developed. In Great Britain there are few large herds which are free from the affection. There is also reason for believing that the disease is spreading. The losses experienced from this cause must be relatively enormous; they arise from the death of calves, the loss of milk, and the sterility which appears as a sequel in many outbreaks. What the aggregate loss amounts to in any country cannot be definitely determined, but its importance may be understood when it is realized that probably more than 90 per cent. of all abortions in cows are due to infection with Bang's bacillus. This disease was shown by Schnert in 1878, and later by Brauer in 1880, to be experimentally transmissible by putting the discharges and fœtal membranes from an infected animal into the vagina of a susceptible pregnant cow. Woodhead, Aitken, McFadyean, and Campbell, in investigations carried on under the auspices of the Highland and Agricultural Society of Scotland in 1889, produced abortion in cows and ewes by inserting into the vagina plugs of wool contaminated by the discharge of aborting cows, and in a cow by giving a subcutaneous injection of a similar material. Galtier also in 1890 infected healthy pregnant cows by feeding them on the fœtal membranes of infected cows.

The actual cause of the disease was first discovered by Bang and his assistant, Stribolt, in 1896, and their discovery has been abundantly confirmed by the subsequent investigations of the Departmental Committee appointed by the Board of Agriculture and Fisheries of Great Britain in 1905, and later by research workers in Europe and America. It is now universally accepted that the organism first discovered by Bang is responsible for the vast majority of abortions in cows of a contagious nature throughout the world.

Etiology.—This organism, the *Bacillus* (or *Brucella*) *abortus Bang*, is a slender bacillus about 1 to 3 microns long, containing one, two, or three granules. It is non-motile and does not sporulate. It stains well with the basic aniline dyes,

but is Gram negative, and is not acid-fast. It is an aerobe, but grows best in an atmosphere deprived of 10 or 15 per cent. of its oxygen. It can be readily cultivated on agar, glycerin broth serum, Stockman's potato agar medium, in glucose broth, etc., and grows best at temperatures between 30° and 37° C. It is destroyed by exposure to a temperature of 55° C. (moist heat) for two hours, and also to a temperature of 59° to 61° C. for ten minutes. It is readily destroyed by ordinary disinfectants, and by desiccation and sunlight. Outside the body, when exposed to weather conditions, sunlight, and desiccation, in discharges in thin layers, it probably does not survive longer than one month; but when protected in dense materials, such as portions of fœtal membranes, it has been known to retain its virulence for four or five months. In cultures, however, it may survive for six or seven months or more. At first it was taken that the infection was confined to the pregnant uterus, and it was shown that the organisms were abundant in the uterine discharge, fœtus, and fœtal membranes of the aborting cow. These materials are still accepted as the chief source of the spread of infection, and on that account the greatest danger of infection from an affected cow to its fellows arises at or after abortion, and until the uterine discharges have ceased. Moreover, it has been shown that after abortion the uterus rapidly expels infection. Occasionally the genital passages of the cow retain the organisms as long as three or four weeks, and in exceptional cases the germs are eliminated within fifty-one or fifty-two days. The prolonged retention in the latter cases is associated with retention of the fœtal membranes.

But it has further been found that some infected cows never abort at all. They breed normally, and even, although they may come to full time, the fœtal membranes and discharges at parturition may be infective. In our experience the proportion of such cases is roughly about one-third of all the infected animals in a herd. These cows are referred to as the "carriers."

It has also been shown that the pregnant uterus is not the only organ in which the organisms of contagious abortion are retained and multiply. Even although the uterus rids itself of infection after abortion or parturition, the animal does not

as a rule promptly recover. The organisms frequently remain located, and propagate in the udder and adjacent lymphatic glands, and are often excreted continuously or intermittently in the milk. This occurs although the udder and the milk show no obvious change. Thirty per cent. of the cows in two herds near Chicago were shown by Evans in 1915 to be excreting the bacilli in the milk. From the udder the uterus may become reinfected at a subsequent pregnancy. Moreover, the disease occasionally attacks the bull. The genital organs are then affected, and the bacilli may be excreted in the semen. Schroeder and Cotton and Buck, Creech and Ladson in America, have demonstrated the presence of lesions in the vesiculæ seminales, testicles, and epididymes of affected bulls due to Bang's bacillus. On this account it is more appropriate to describe this disease as "abortion disease," or Bang's disease, than as "contagious abortion."

Another peculiarity of this disease which has come to light in recent years is that, although calves are born of infected cows, and may presumably harbour the organisms on or in their bodies at birth, they soon rid themselves of the germs, and nearly always make a complete recovery before they reach maturity. It is very exceptional to find maiden heifers and young bulls the subject of this infection. It is evident, therefore, that Bang's disease is a disease of sexual maturity.

Experimentally, Bang's bacillus has produced abortion in ewes, goats, mares, bitches, and guinea-pigs. But under natural circumstances the only other animal besides the bovine which has contracted the disease is the pig, and the only outbreaks so far noted in the pig have occurred in America.

Methods of Infection.—The disease is most commonly introduced into a herd by an infected cow, and the transference occurs as a rule after abortion or calving by contamination of the food or water, or the coats of the animals either directly or indirectly with infective material. The source of infective material is the uterine discharge, fœtal membranes, or fœtus. The discharges, etc., may occasionally be carried some distance in manure by dogs, birds, or human beings. It has also been suggested that the milk of infected cows may be a source of danger, but there is no evidence that such milk is a medium through

which the disease is spread. It is extremely unlikely that, except through gross carelessness, it would be a direct source of infection. Even when calves are fed with such milk no trouble appears to arise in these animals judging from the results obtained by testing them for the presence of infection. Possibly their droppings may contain active bacilli so long as the infected milk diet is continued.

It is now generally accepted that cattle are infected by ingestion of contaminated food or water, or by licking the coats of their fellows infected with discharge. There is no evidence that the disease is contracted under natural conditions by cows through the genital passage even during service, and the experimental evidence does not favour the view that the bull transfers the disease during service. The bull is not now accorded the same importance in the spread of the disease as in the earlier days. Nevertheless, under certain conditions the bull may be a source of danger. He may be infected and his semen charged with the bacilli of Bang. On this account the semen, if it falls on the ground and contaminates the food or the coats of cows brought to him for service, may be a medium of infection. Moreover, an infected cow which has recently aborted, when brought to him for service, may contaminate the bull's coat or the place in which service takes place. The bull is probably infected in the same way as the cow, but infection may also take place through the sheath.

Artificially the cow has been infected through the teat duct, but that is not likely to be a natural route of infection.

The *Period of Incubation* in this disease, if taken as the period which elapses between infection and abortion, has been shown experimentally to vary between 33 and 230 days, the average being 126 days.

Symptoms.—The symptom of this disease which attracts attention is abortion. In an outbreak from 5 to 95 per cent. of cows or heifers may be affected. Frequently the disease is not suspected until one-third or one-half of the herd come to be involved. A common history of an outbreak is that during the first year an occasional abortion has occurred to which no attention is drawn, while in the second year there are many abortions, but in subsequent years the number of abortions gradually decreases until after a time the disease appears to

die out. But the disease may flare up again in the same herd at some future date even although the herd may be self-contained, if no attempt is made to get rid of infected animals. That is a common experience when cows are bought indiscriminately to form a new herd.

The period of pregnancy at which abortion occurs varies very greatly. It only occasionally occurs before the third month, and most commonly from the fifth month onwards. Indeed, in many of the cases it might be more correctly referred to as premature calving. Little or no indication is given of the imminence of the accident in the earlier periods, and at the later periods the signs of impending abortion are similar to those of parturition, but they develop very rapidly. In the early stages the fœtus is expelled with or in its membranes, while in the later stages, although there is little difficulty experienced in the expulsion of the fœtus, the fœtal membranes are often retained and are very adherent.

The fœtus is usually born dead, but after the fifth month may be alive but weakly, and frequently dies after exhibiting rattling breathing or dyspnœa and a rust-coloured mucilaginous discharge from the nostrils. Some of the calves of eight months' pregnancy or over survive and may do well.

An important feature of abortion is the appearance of a thin yellow flocculent uterine discharge which is often copious, but may be slight in the early abortions. It comes away immediately before and during abortion, and may afterwards persist for a period of weeks, longest when the membranes are retained. The discharge is greatest in the later abortions.

Subsequent History.—Retention of the fœtal membranes occasionally gives rise to uterine catarrh or metritis. The disease is not as a rule dangerous to the life of the cow. In the large majority of cases a cow aborts only once. Only occasionally does abortion occur twice, rarely three times. The abortions when they are repeated may occur in consecutive pregnancies, but in some instances the cows may calve normally once or twice and then abort again. But even if abortion occurs only once, the cow does not recover from the infection—at least, for a considerable time—and therefore becomes a carrier. Seldom does recovery take place within a

year, and probably not more than 30 per cent. recover in a period of seven or eight years. The infection may be retained for life, although the animal may show no symptoms. It remains a "carrier." An important accompaniment or sequel of the disease is sterility, which may be temporary or permanent. The percentage of sterile cows in an outbreak varies a great deal. The sterility does not appear to be directly due to Bang's bacillus because that organism does not appreciably affect the uterine mucous membrane ; it attacks the chorionic epithelium, the endothelial cells of the chorionic vessels, and the fœtus. In many cases the sterility is due to some secondary organisms which invade the genital apparatus.

Pathological Anatomy.—If the uterus of an affected cow be examined in the later stages of pregnancy, a varying amount of the exudate is found between the uterine mucous membrane and the chorion, especially round the cotyledons. This exudate is usually abundant and odourless, dirty yellow in colour, somewhat thin and lumpy or pultaceous and slimy. Yellow solid floccules are suspended in it and adhere to the fœtal membranes. The fœtal membranes are frequently œdematous, occasionally thickened and leathery. Many of the cotyledons are softer than normal, even pulpy, and distinctly yellow in colour or necrotic-looking. The fœtus is somewhat œdematous, or affected with dropsy of the abdomen or thorax. Occasionally it is mummified, but never putrid. The umbilical cord is frequently dropsical.

Diagnosis.—In the vast majority of outbreaks there is little doubt as to the presence of the disease when several abortions occur in succession in a herd. The early recognition of the disease is of the utmost importance in its control and for its early eradication, and therefore a single abortion in a herd should always be regarded as contagious until the contrary is proved. Clinical features of individual abortions which may excite suspicion comprise the ease with which abortion occurs, the yellow, slimy, flocculent character of the uterine discharge, and the yellow, necrotic-looking cotyledons on the fœtal membranes. The microscopic examination of films prepared from the fresh uncontaminated membranes or exudate is of some service in diagnosis. The small Gram-negative bacilli may be found in considerable numbers and in

clumps. But such material is often rendered valueless for this purpose by contamination and decomposition and is often not available.

Abortin was first recommended by the British committee of investigation as a useful diagnostic agent. Abortin is a preparation made from liquid cultures of the *Bacillus abortus Bang*, in a similar way to tuberculin. It was injected subcutaneously and gave a temperature reaction. It did not prove to be satisfactory. A test similar to the double intradermal test for tuberculosis has been tried experimentally, but its utility in the field has yet to be proved. Since 1912 *complement fixation* and *agglutination tests* have come to be recognized as of great value in diagnosis. The *agglutination test* is now generally adopted for the recognition of infection with Bang's disease in preference to the complement fixation test because it is equally reliable and is much simpler in application. For the application of the agglutination test a sample of blood is obtained from the jugular vein or from one of the ear veins. About ½ to 1 ounce is required, and it should be taken free from contamination. The blood is allowed to clot. The serum is then collected. It is then diluted in appropriate amount with normal saline solution containing ½ per cent. carbolic acid, and measured quantities of the diluted serum are added to definite quantities of an emulsion of the bacilli of Bang. For each test a series of tubes containing various dilutions of serum and emulsion are prepared and incubated at 37° C. for twenty-four hours and the result then read off. When complete agglutination occurs, the emulsion becomes quite transparent and little clumps of bacteria will have fallen to the bottom of the tube.

A positive reaction is indicated when complete agglutination takes place in dilutions of serum of at least 1-50, but the reaction may be as high as 1-2,000 or more. A reaction is to be regarded as suspicious when the agglutination is complete in 1-25 and incomplete in 1-50, while the result is regarded as negative where there is no agglutination above 1-25. The test is an extremely reliable one, and in that respect compares favourably with tuberculin. A reaction indicates the presence of Bang's disease, but it does not indicate whether an animal has aborted or is likely to abort. No re-

action is given for a time after infection. The interval that occurs between infection and reaction is in all probability not greater than a month. One important occasional defect of the test is that a pregnant animal, particularly a heifer, may not react till abortion takes place or even for a period of two or three weeks afterwards.

Treatment.—It has to be admitted that the disease when it appears is incurable, and no therapeutic agent has yet been found which will destroy the infection within the body. Carbolic acid, methylene blue, and potassium iodide acquired an unmerited reputation in this respect. For the present the only measures which can be recommended are directed either to the eradication of the disease from a herd or the immunization of cows and heifers exposed to infection. The first is the ideal to be aimed at, and should in fact be the ultimate object of control.

Whichever method be adopted, whenever an abortion occurs in a herd the animal should be promptly isolated on suspicion. The dead fœtus and the fœtal membranes must be destroyed by fire or buried deeply in quicklime. The house and litter where the abortion occurs must be disinfected, or if the abortion occurs at grass the contaminated area may be disinfected with quicklime or sprayed with disinfectant or a layer of straw burnt over it. The cow must be kept in a separate house and looked after by attendants who use special overalls for the purpose and disinfect their hands and boots before leaving. The fœtal membranes when retained should be removed at an early date. The floor and bedding should be sprayed with a reliable disinfectant daily, and the vulva, tail, and hindquarters cleansed and also disinfected daily. Reliable disinfectants include 1 per cent. lysol, creolin, cresyl, or 2 per cent. copper sulphate solution.

The aborting cow must be kept isolated at least until all uterine discharge has ceased, and before being let out its tail and quarters should be washed and its coat and feet sprayed with a reliable disinfectant.

In the meantime a blood sample should be withdrawn from the aborting animal and submitted to the agglutination test. If it does not react, a second sample should be tested in a month's time. If a positive reaction is given, it may be

thought desirable to test all the sexually mature cattle in the herd in order to ascertain to what extent the herd is affected before deciding on the further course of action.

(*a*) *The Method of Isolation and Eradication.*—This is very similar to the Bang system for the control of tuberculosis save that the calves may be left with affected cows until they are weaned. In this method facilities must be available to house the affected and healthy cattle in separate sheds, and to provide them with separate grazing pasture. Separate attendants are not essential so long as disinfectant precautions are taken. All utensils must be disinfected before being used for the healthy cattle.

All the mature cattle—cows, heifers, and bulls—are tested, and then separated into two lots, the reactors and non-reactors.

The non-reactors must be kept in a house which has been thoroughly disinfected and grazed on separate pastures which had not recently been used by infected cattle.

The non-reactors must be tested in a month's time and any animals reacting must be separated and placed with the reactors. If the reactors are few in number, and not valuable, they may be got rid of to the butcher. Valuable animals may be kept and bred from. A separate bull is not essential. If, however, one bull is kept for the whole herd, infected animals should be brought to him for service, and the ground and his coat should be sprayed with a disinfectant after service. The hairs around the preputial orifice should be cut short, and it is a good practice to syringe out the sheath with a non-irritant antiseptic after service. In no case should the bull be allowed to run with the infected portion of the herd. A reacting bull should not be kept for breeding purposes.

The calves of the reactors when they come near puberty are tested, and if they do not react are added to the healthy portion of the herd.

In that way the healthy portion of the herd becomes gradually augmented and the reactors in the natural course of events are gradually sold off.

All new cattle brought into the herd must be tested on two occasions, with an interval of a month between the tests, and can be regarded as free from infection only when they have

passed the two tests, and they should be kept in isolation until then. One advises that the herd should be self-contained in the sense that the vacancies should as far as possible be filled by the heifers bred on the farm. Such herds offer the best chance of diminution of the disease. If cattle must be brought into the herd, then those which carry the least risk of introducing the disease are maiden heifers.

If abortion is threatened at any time in the healthy part of the herd, the aborting animal must be strictly isolated and a sample of blood taken and subjected to the agglutination test. If a positive reaction is given, then a general test of the incontact healthy animals should be carried out as early as possible, and any cattle reacting to the test transferred to the reacting portion of the herd.

In the reactor section of the herd all cows or heifers showing signs of calving or abortion should be isolated and dealt with as already noted for the first case of suspected contagious abortion. In that way gross contamination of pasture or house is avoided.

Afterwards a yearly test of the whole herd may with advantage be carried out until the affected animals have been eliminated. No reactor animal should be admitted to the healthy section unless it has passed the test on at least two occasions at an interval of about three months.

This system may be recommended for pure-bred herds and for herds where the infection is not widespread, and particularly self-contained herds. The scheme requires care and vigilance. The time taken for eradication will vary with the number of affected animals and the rate at which they are got rid of to the butcher. It may take several years where a large proportion of the herd is infected, but may occupy a very short time if the first case of abortion is promptly recognized.

(*b*) *Control by Immunization.*—It has been shown that dead vaccines are valueless to prevent either infection or abortion. The vaccine which has now come into general use is a living liquid broth culture of Bang's bacillus. The dose commonly used is 50 c.c., and it is injected subcutaneously. Great care should be taken to avoid spilling the vaccine on the ground, and the usual surgical cleanliness should be strictly observed to prevent the entrance of extraneous organisms and the consequent abscess formation. After the injection the animal

may be slightly fevered for a few days and a slight swelling may form round the site of inoculation. The object of this vaccination is to set up some degree of immunity against the disease, but it is never so great as to withstand gross infection. Therefore aborting animals should be isolated till after the discharge has ceased, and the other measures adopted as noted in the preliminary procedure. Vaccinated animals will react to the agglutination test for some time and occasionally become carriers. Since there is a danger of setting up infection and even abortion with this vaccine, pregnant animals should never be inoculated. Only heifers and non-pregnant cows should be vaccinated, the heifers before they are to be bred from and the cows when the discharges after abortion or parturition have ceased. Bulls should never be inoculated; they are seldom infected in outbreaks, and in the interests of the herd should be kept free from any danger of infection, and the same precautions taken with them as in the procedure of isolation.

Cows or heifers after vaccination should not be sent to the bull for at least two or three months. Vaccination does not get rid of infection, but it is valuable in the sense that it may reduce the number of abortions in a herd. It does not appear to have any effect on subsequent sterility. All cows or heifers brought into the herd should be vaccinated before service. So far as possible all vacancies in the herd should be filled by heifers born and bred on the farm. Vaccination should be discontinued only after abortions have ceased, but it may be advisable to vaccinate annually or every second year while the abortions are occurring.

In the self-contained herd the disease may ultimately be eradicated after discontinuing vaccination by testing and fattening the reactors for the butcher.

Vaccination is recommended for badly infected herds where the cows are bought in the open market and where there are no facilities for isolation.

Once a herd has been freed of Bang's disease it may be kept free by testing all cattle bought in, and by preventing contact, direct or indirect, with affected or reacting cattle.

When sterility appears in this disease, it must be dealt with along the lines already described.

Infectious Abortion in Mares.

Infectious abortion in mares has in some years and in various countries been responsible for very serious losses. Losses due to this cause have been already referred to as occurring in America. It has also been reported as appearing as an enzootic in certain parts of Europe and in India.

Etiology.—It has been ascertained that this disease is usually set up by a bacillus of the Salmonella group, the *Bacillus abortus equi.* The bacillus is distinguished from other members of the same group by its peculiar dry wrinkled growth on agar and by carbohydrate and serological reactions. These bacteria have been isolated from the vagina after abortion, from the fœtal membranes, and from the serous fluid of the serous cavities, and also from the intestinal contents and the joints of the fœtus after abortion. With this organism abortion has been set up by intravenous injection and by feeding.

Although this bacillus has been most commonly found in infectious abortion in mares, other organisms, including Gram-negative streptococci, staphylococci, and colon bacilli have sometimes been associated with outbreaks of equine abortion.

Method of Infection.—Apparently in many cases the source of infection has not been traced, and it is possible that some at least of the organisms may at times lead a saprophytic existence.

Probably the disease is sometimes introduced into a stud by an infected mare, while in other instances men who have handled affected animals have carried the infection from one stable to another (Guillercy). Apparently the infection gains entrance by ingestion of contaminated food or water, but there is no definite evidence to show that the stallion conveys the disease during copulation.

The *Period of Incubation* seems to be much shorter than in cattle.. After experimental inoculation abortion occurred in ten to fourteen days.

The *Symptoms* of infectious equine abortion do not differ much from those observed in the cow. Mares usually abort between the fourth and the eighth month. In the American

outbreaks, the first indication observed was the return of œstrus in mares supposed to be some months pregnant. The animals being at pasture, the expelled fœtuses escaped detection until, in some of the mares, abortion took place in the later stages of pregnancy. Preceding abortion there may be symptoms of slight colic, some swelling of the mammary glands, and a white, slimy, purulent, vaginal discharge. After abortion the discharge frequently disappears in a few days. Foals which live after abortion or which are born at full time in an outbreak often become the subjects of joint ill. Occasional sequels of abortion are arthritis, laminitis, pneumonia, metritis, sterility, or repeated abortions.

Some of the outbreaks of equine abortion subsided spontaneously, and thus gave rise to the impression that there was some predisposing factor in addition to the exciting cause.

The lesions do not appear to be characteristic. There are sometimes necrotic changes in some of the villi of the placenta, and the chorion is œdematous. The fœtus presents some subcutaneous sero-sanguinolent œdema and serous fluid in variable quantity in the serous cavities, with inflammation of the stomach and intestines.

The *Diagnosis* is made from the succession of abortions and the isolation of the bacteria from the discharges, fœtal membranes, or fœtus. In the blood of affected mares specific agglutinins develop and a serum agglutination test may be adopted in which a reaction is regarded as positive when the agglutination titre rises to 1-1,000 and over.

Treatment.—The measures recommended against contagious abortion in mares are simpler than in Bang's disease. They consist in the disposal by fire of the dead fœtus and fœtal membranes, the complete isolation of the infected mares, and thorough disinfection of the stable and objects likely to have been contaminated. The mares should be isolated in a box or paddock at some distance from the healthy animals and the attendants must take precautions against carrying the infection. The vagina and uterus should be douched out with mild antiseptic injections on at least two or three occasions. The food supply should be changed. Mares which have aborted should not be put to the stallion for at least six weeks.

Vaccines have been used in treatment, but their value has not been demonstrated.

Foals affected with joint ill if allowed to live must be separated from pregnant mares. All mares which are dams of foals with affected joints must be treated as infected.

Contagious Abortion in other Animals.

Contagious abortion has also been noted in ewes, goats, and swine. In certain outbreaks in ewes in Great Britain the disease has been shown to be due to a vibrio. As distinguished from bovine abortion, the uterine discharge after abortion is often mucoid, rusty coloured, or blood-stained, and the vagina may contain some of the discharges even during pregnancy.

Infection probably takes place by ingestion and also to some extent through the ram during copulation.

In the control of the disease attention is directed to the disposal by fire of the dead fœtus and fœtal membranes, the separation of affected ewes, and disinfection. If the ram is responsible, it should be disposed of to the butcher.

In swine, outbreaks of contagious abortion have been found to be due to *Bacillus abortus Bang* in the United States of America. Apparently the strain found in swine is more virulent for guinea-pigs than that found in cattle. The methods of control adopted are similar to those noted for cattle.

It may be mentioned as a matter of interest that the *Bacillus abortus Bang* closely resembles the *Brucella melitensis*, and that in recent years an organism which appears to be indistinguishable from the *Bacillus abortus Bang* has been isolated from human patients showing symptoms like those of undulant fever.

CHAPTER IV

NORMAL PARTURITION

Normal, natural, or physiological parturition, or labour, is the expulsion of the fœtus from the uterus through the maternal passages by natural forces, when it is sufficiently developed to live external to its parent. This act is designated "foaling" in the mare, "calving" in the cow, "lambing" in the ewe, "kidding" in the goat, "farrowing" in the sow, "pupping" or "whelping" in the bitch, and "kittening" in the cat. The term "abnormal," or "pathological," or "difficult," is applied to parturition when the aid of man is required to relieve the parent and release the progeny. The interval between normal and pathological parturition is sometimes extremely brief, a very slight change—*e.g.*, of a limb or head of the fœtus—being sufficient to bring about the transformation.

PHYSIOLOGY OF PARTURITION.

The act of parturition is distinguished from all other physiological processes by being accompanied by pain, general disturbance and uneasiness, and violent efforts. Frequent and wide deviations even in normal birth commonly occur in species and individuals, not only in regard to its duration or the duration of its stages, the intensity, duration, and frequency of the "labour pains," or utero-abdominal contractions, but also in regard to the positions presented by the fœtus for its expulsion.

The *Causes of Parturition* are not definitely known. As the fœtus increases in size, certain alterations occur both in the uterus and the fœtal attachments which prepare for the

expulsion of the young creature. A gradually increasing fatty degeneration affects the outer layer of the placenta, and its union with the uterus becomes less intimate, while a larger supply of blood is required for the mammæ, for the secretion of milk. The exchange of materials between the uterus and fœtus is lessened, and the latter—always more or less of a parasite—becomes like a foreign body in the cavity of the former. No doubt the act is a reflex one, and brought about by irritation of the uterine mucous membrane by the fœtus or by certain changes occurring in connection with it.

The Expelling Powers.—The expulsive force by which parturition is affected resides in the non-striped muscle fibres of the uterus; these cause the organ to contract in a rhythmical and somewhat peristaltic manner, the contraction of the abdominal muscles and diaphragm being merely auxiliary. The uterine contractions are usually accompanied by a painful sensation, due to the pressure exercised on the nerve terminals, and are hence commonly called "labour pains" (*dolores ad partum*). Expulsion is not affected by one contraction, but by a series of contractions. At the commencement the contractions are feeble and short, and the intervals between them long. There is also a certain gradation in each contraction. Feeble at first, it increases in intensity until its maximum is reached, persists for some time, and then gradually subsides. As parturition progresses, the separation between uterus and fœtus increases, the contractions increase in intensity and duration, while the intervals become shorter. These intermissions permit of the recovery of the mother and fœtus from the inconvenience occasioned, and permit of the preparation of the genital passage for the exit of the fœtus. During each regular pain the whole of the uterus contracts. The cornua become twisted on themselves anteriorly, are shortened through the action of the longitudinal fibres, and are brought nearer the body of the uterus, which is also shortened. The sum total of the expelling force is thus centred on the cervix, and by means of the incompressible liquor amnii gradually opens the os uteri for the extrusion of the fœtus. The cervix gradually becomes thinner, and the os is slighly opened. The membranes containing the fœtal fluids enter the os, and act as mechanical

dilators; then the lower parts of the fore-limbs, succeeded by the head of the fœtus, are introduced, and from their combined shape act like a wedge, until, by eccentric pressue, the chest of the fœtus is passed in, and the os is thus so much dilated that the uterus and vagina constitute a common cavity. Owing to the equal pressure exerted upon it, the os is usually circular at this stage. At first the dilatation is slow, especially in primiparæ or when the croup is presented or the body of the uterus inclines too much downwards, causing the cervix to bend upwards towards the sacrum. As soon, however, as the mechanical action of the water-bag and fœtus comes into operation, it makes rapid progress in natural parturition.

In uniparous animals in twin pregnancy, each fœtus lives in one horn, and the two cornua are of equal size. The fœtuses usually present anteriorly, sometimes posteriorly or one posteriorly. Here parturition is more difficult and slower than when there is one fœtus. The uterine contractions commence almost simultaneously in both cornua, and the fœtus which is most advanced or largest is delivered first. The second fœtus is usually expelled, in the mare, in less than ten minutes after the first; in the cow it may be one or two hours, and in the ewe half an hour; and frequently delivery is more rapid and easier than with the first fœtus. When the number of fœtuses is greater, they are expelled successively at intervals of some hours.

With the small multiparous animals in which the fœtuses are expelled one after the other, it may be admitted that each fraction of the uterus corresponding to a fœtus contracts in its turn — at first the segment of one of the cornua nearest the cervix, then the next segment, and so on, until the one in proximity to the ovary is reached, so as to get rid of all successively, one cornu expelling a fœtus alternately with the other. The uterine contractions are very powerful, as is noted by the obstetrist in inserting his hand between the fœtus and uterine wall during parturition; and their force is not always related to the general physical powers of the animal, though they are always more energetic in the mare than the cow, as well as more continuous.

After the os is completely dilated, the circular as well as

the longitudinal muscular fibres are brought into action simultaneously in order to diminish the uterine cavity and quite expel its contents, and in this they are greatly aided by the abdominal muscles and the diaphragm. The animal "strains" with all its force, and these throes, which are involuntary to a great extent, soon bring the act to a termination. During the act the fœtus is more or less passive. In order to make birth possible, the expelling forces must be greater than the resistance caused by the fœtus and its membranes and the genital passage. The fæces accumulated in the rectum, or urine in the bladder, sometimes increase the resistance to be overcome.

The fœtal membranes in being expelled appear between the lips of the vulva as a round, distended tumour filled with fluid—the "water-bag," at the moment a pain appears, but flaccid in the interval. The distension of the membranes increases with the contractions, and soon the fœtal membranes rupture, when the allantoic and then the amniotic fluids escape from them, leaving a variable quantity in the uterus, of which some is discharged in the vagina during each contraction, and aids in the passage of the fœtus by lubricating the mucous membrane.

The period at which rupture occurs varies. In the mare the membranes are thicker, tougher, and much less adherent to the uterus, than in the cow, and so rupture later; sometimes they remain intact until the fœtus is born. The latter never occurs in the cow. If the membranes rupture early, the genital mucous membrane and fœtus become dry, and parturition is rendered difficult or prolonged and dangerous to the life of the fœtus.

Signs and Course of Parturition.

The entire period of labour or parturition is, for convenience of description, divided into four stages: (1) Preliminary stage; (2) dilatation of the os uteri; (3) expulsion of the fœtus; (4) expulsion of the membranes.

1. *The Preliminary Stage* may occupy some hours, sometimes even several days, before labour proper sets in.

The mammary glands become voluminous, hard, and tender, especially marked in primiparæ. The development of the

mammæ may be so considerable that the engorgement extends along the inferior surface of the abdomen like an œdema, or ascends between the thighs as high as the vulva as a prominent ridge, while the skin in this region, if unpigmented, is reddened. This is noted especially in the mare. At a later period the teat yields a serous fluid on pressure; the fluid afterwards becomes lactescent, and finally appears as the "colostrum," or first milk.

The vulva becomes tumefied, the space increases between the labia; the latter are soft and flabby, while their lining membrane is reddened, and a viscid, glairy mucus covers it. This mucus soon becomes abundant, and is discharged in strings, especially in the cow, and soils the tail and hocks.

With these changes the abdomen becomes more pendent, the flanks and croup look hollow. The spine, particularly in the lumbar region, becomes more horizontal, and even inclines downwards. The haunches appear to be wider apart, and the gluteal muscles subside owing to slackening of the sacro-sciatic and sacro-iliac ligaments.

The animal walks sluggishly and unwillingly, and, if at pasture, remains separate from its fellows. The cervix uteri at this time is almost completely effaced, being reduced to a thin circular ring, the tissue of which is soft, and the os slightly opened if the animal has previously had young.

These phenomena are most marked immediately prior to parturition.

The animal also begins to be restless and continually agitated; if feeding, it stops frequently for some minutes, probably as the result of the commencing contractions of the uterus. The mare whisks its tail, the cow bellows, the ewe bleats, the bitch often whines, and the cat emits a low cry. If the animal is at liberty, it seeks a remote, quiet place in which to bring forth its young; while some, such as the bitch, cat, sow, and rabbit, prepare a special nest. These are the common symptoms indicative of approaching parturition; occasionally they are deceptive, and they do not indicate the hour or day at which parturition will take place. Occasionally they occur a few weeks before the actual occurrence.

2. *Dilatation of the Os Uteri.*—This stage is not well marked off from the first one.

It is marked by increasing uneasiness of the animal—pawing, lying down and rising frequently, in a kind of aimless fashion; while the expression and physiognomy betray suffering. When the uterine contractions really commence, the creature suddenly stops, as if surprised by the pain; its eye looks animated and expresses anguish; the skin is hot, the pulse quickened, visible mucous membranes injected; the abdominal walls are rigid and contracted, the flank is tense, and very frequently fæces or urine is voided. During this pain, if the cervix uteri is explored, it will be found that its attenuated border tends to become hard and prominent. When the pain has passed, calm succeeds; the cervix becomes thick and elastic, and the os is markedly enlarged. Each pain lasts for some seconds to two or three minutes, the interval of quiet continuing for about fifteen minutes at first, though it diminishes when the contractions become more frequent, more energetic, and more prolonged, and dilatation of the os progresses. Then the fœtal membranes begin to be detached from the inner surface of the uterus and enter the os, whence they pass into the vagina and between the labia of the vulva, where they appear externally as the "water-bag." In the meantime the fore-limbs and head of the fœtus enter the os and dilate it to its fullest extent, when the cavity of the uterus becomes continuous with the vagina.

3. *Expulsion of the Fœtus.*—The pains become more severe, frequent, and sustained, and to the uterine contractions are added those of the diaphragm, and abdominal and other muscles. If the animal is standing, it brings all its limbs under the body, arches the back, elevates the tail, slightly flexes the hocks, makes a deep inspiration, closes the glottis, and strains to propel the fœtus into the pelvis and rupture the chorion. At each contraction the "water-bag" protrudes farther beyond the vulva, where it has the appearance of a bladder. The "water-bag" usually soon ruptures at its most dependent part, and its contents partly escape, that in front of the thorax of the fœtus being retained, and voided only in small quantities to lubricate the passage. The rupture of the membranes occurs earliest in primiparæ, and sometimes in protracted labour. Occasionally in the mare the membranes do not rupture until the fœtus is expelled.

As a rule the fore-feet and the muzzle lying over and between them appear at the vulva, and form a kind of cone to bring about a gradual dilatation of the vagina. In the large animals the feet come first, and the muzzle lies above the metacarpus. In the carnivora, the head, being large, appears first, and the fore-limbs often lie at the side of or under the fœtal chest. In posterior presentation, which sometimes normally occurs, the hind-feet appear together, and the hind-limbs act also as a wedge or cone in causing dilatation of the genital passage.

When the head has cleared the vulva, there is usually a short pause, as if to allow the tissues of this region to become

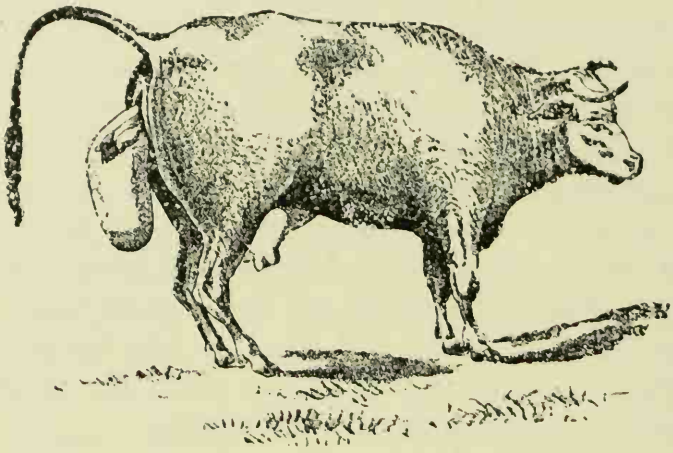

FIG. 56.—COW IN THE ACT OF PARTURITION. STANDING POSITION.

accustomed to the distension, and to prepare them for the still greater strain which is yet to be imposed on them. The thorax and shoulders have now arrived at the inlet of the pelvis, and, as they form the greatest thickness of the trunk, the contractions which ensue are most powerful and continuous, and slowly impel it to the outlet, on arriving at which a more energetic and painful effort than all the others pushes it through. The bitch and cat often utter a cry of pain at this point. The expulsion of the remaining portion of the body is comparatively easy, as even the croup presents little difficulty, and the process is facilitated by the weight of the anterior portion of the body hanging from the vulva.

The position assumed by animals during parturition is somewhat variable. The mare, cow, and sheep, usually give

birth standing. Sometimes, more especially, the cow brings forth in the reclining position, only rising when the act is accomplished. When reclining, the animal rests on the sternum, the body inclined to one side, the fore-limbs beneath the chest, and the hind ones partly under the abdomen. It usually only lies at full length during a long, difficult, and exhausting labour.

The bitch, the cat, and the sow, always assume the recumbent position, inclining on one side, the head directed towards the tail. Each fœtus, as it issues from the vulva, is within reach of the mother's mouth. The mother removes the membranes

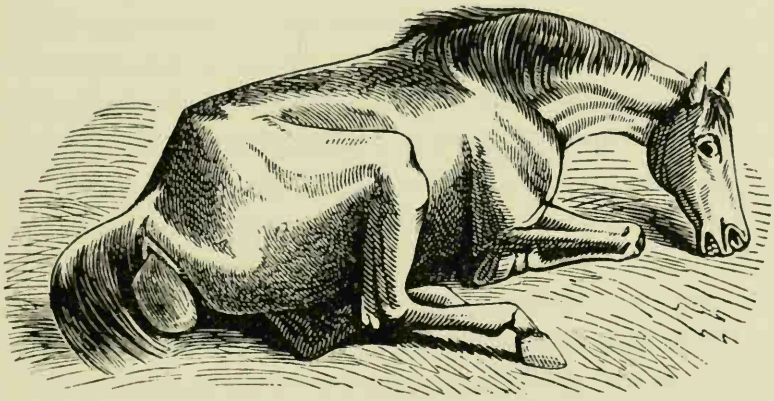

FIG. 57.—MARE IN THE ACT OF PARTURITION: RECUMBENT POSITION (BAUMEISTER.)

from it, divides the umbilical cord, cleans the fœtus with its tongue, puts it in a proper position, and even directs its head towards the teat.

The *total duration of parturition* is extremely variable, according to species, individuals, and accidental circumstances. With mares it is usually brief, and accomplished in from five to fifteen minutes. The rapidity appears to be due to the fact that the placenta is detached from the uterus during the early pains, and consequently the fœtus cannot live long after this occurs—three or four hours being supposed to be the limit—unless it can breathe by the lungs. The duration of parturition in the cow is, on the average, one to two hours; though it may be only fifteen minutes, or may be extended, without injury to the calf, to one or two days. The pains are not so powerful or continuous as in the mare.

In the sheep the period is also brief, being about fifteen minutes. If there are several lambs, there is usually an interval of fifteen minutes to two hours between them. In the sow, bitch, and cat, there is usually a period of ten to thirty minutes, sometimes an hour or more, between each birth. Not infrequently the sow will bring forth ten young ones within the course of an hour.

In those animals which are delivered in the standing position, the umbilical cord is ruptured when the fœtus reaches the ground. In the cow the cord is so short that it ruptures before the hind-feet usually leave the vagina. If the mother is recumbent, the cord is torn as she gets up immediately after parturition. Sometimes, however, the cord is sufficiently strong and elastic to resist spontaneous rupture, and the young creature is born with the membranes attached to it. The mother then by a remarkable instinct, in cleansing the young creature with its tongue, gnaws the cord and sets free its progeny. This is occasionally noted in the mare, and is quite normal in carnivora.

The rupture of the cord usually occurs a short distance from the umbilicus, at about 2 inches in the foal—sometimes at 5 or 6 inches. The bloodvessels then recoil towards the abdomen by the action of their elastic fibres, and the laceration and cold soon check any slight hæmorrhage. Even if the cord is cut through with knife and scissors, no serious results are to be apprehended. Hæmorrhage, however, has been recorded in very rare cases in foals, by Béranger of Carpi, and one case in the calf from this cause, by Peuch. The portion of the cord remaining attached to the umbilicus soon becomes dry and withered, and falls off in a few days.

4. *Expulsion of the Membranes.*—The expulsion of the fœtal membranes, or "afterbirth," as they are commonly called, may occur at or immediately after birth, or be delayed for a variable period depending on species and individual.

Immediately after the fœtus is expelled, the uterus contracts and retracts energetically on itself, and its internal capacity rapidly diminishes; consequently the placental villosities are detached from their crypts, and the placenta is ultimately separated from the uterus. These same uterine contractions force the detached fœtal membranes through the

gaping flaccid os into the vagina, and, together with the action of the abdominal muscles and diaphragm, which is again stimulated and sometimes aided by the weight of the fœtus and the umbilical cord outside the vagina, the membranes are pushed out through the vulva. Seldom is the expulsion of the fœtal membranes followed by hæmorrhage. The contractions of the vagina probably give little, if any, assistance in this process.

With the mare, owing to the disseminated placenta and the slight adherence of the placental villi, the separation of the membranes takes place rapidly; indeed, the foal is not infrequently born in the intact envelopes. In the latter case, if the mare should chance to be tied in a stall, assistance may be necessary to extract the foal from its membranes and prevent asphyxia. But generally a few minutes elapse before the afterbirth is detached. Retention of the placenta is therefore exceedingly rare in the mare. When it does occur it is very dangerous, and in attempting its removal there is a great risk of hæmorrhage.

With the cow, because of the multiple placentulæ, the number of which may be over a hundred, the adhesion between the uterus and fœtal membranes is very intimate; while the small volume of the cotyledons offers but little surface for the uterine contractions to act upon. So that while it happens that the calf is never born in its intact envelopes, it is also the case that the afterbirth is only slowly and tardily extruded, two or more hours, or even days, being required. Retention of the placenta occurs frequently in cows, and the envelopes often then require to be removed artificially.

Multiparous animals get rid of the envelopes immediately after, sometimes with each fœtus and without any difficulty. Occasionally the last fœtal membranes are retained. In multiple birth in uniparous animals, the fœtal membranes of the first fœtus may not be got rid of, if they are not in the way, until the second fœtus is born.

The bitch, cat, sow, cow, and even sometimes the mare, devour the membranes as soon as they are expelled, if they are not quickly removed from beyond their reach. This habit does not usually appear to cause any inconvenience to the

animal. Occasionally it causes the symptoms of choking in the cow.

The early expulsion of the membranes is very necessary, as these materials become infected and decompose rapidly, and if left may set up metritis. After their expulsion the uterus contracts further upon itself, so as to occlude its lumen and again maintain its freedom from infection. It rapidly decreases in volume, but never returns to the size of the virgin organ. The uterine mucous membrane returns to its original condition, and in the cow and ewe the cotyledons become very much smaller. The cervix uteri contracts rapidly, and the os closes within a few days.

PRESENTATIONS OF THE FŒTUS AND MECHANISMS OF PARTURITION.

In studying the mechanism of parturition it is necessary to recognize—

A. **The Presentation of the Fœtus**—*i.e.*, the region of its body first presented to the pelvic inlet. The fœtus when covered by its envelopes has the form of an elongated oval body, which may be passed towards the pelvis, like a cork to the neck of a bottle, in three ways, either by one of its ends or by its middle. In the first instance the long axis of the fœtus lies parallel to the long axis of the body ; in the second instance it lies at right angles. The fundamental presentations considered in this way are—

1. *Anterior Presentation*, in which the anterior portion of the body of the fœtus is directed towards the pelvic inlet. This may consist of the head and fore-limb or the chest.

2. *Posterior Presentation*, in which the posterior extremity of the body of the fœtus is directed towards the pelvic inlet.

3. *Dorso-Lumbar* or *Dorsal Presentation*, in which any portion of the dorsal aspect of the body of the fœtus, such as the back, loins, or other portion of the spine, faces the inlet of the pelvis.

4. *Sterno-Abdominal* or *Ventral Presentation*, in which the ventral aspect of the body, with some of the limbs, is directed towards the pelvis.

In the last two presentations the long axis of the fœtus is at right angles to that of the mother.

B. **Position of the Fœtus.**—The presentation being determined by the part of the fœtus which offers at the pelvic inlet, it must be evident that this part, whichever it chance to be, may vary considerably in its relation to the circumference of the passage. The position of the fœtus is the relation of a determinate point on the surface of the fœtus to an equally determinate point of the pelvic circumference. These points in the mother are constant, and consist of sacrum above, the

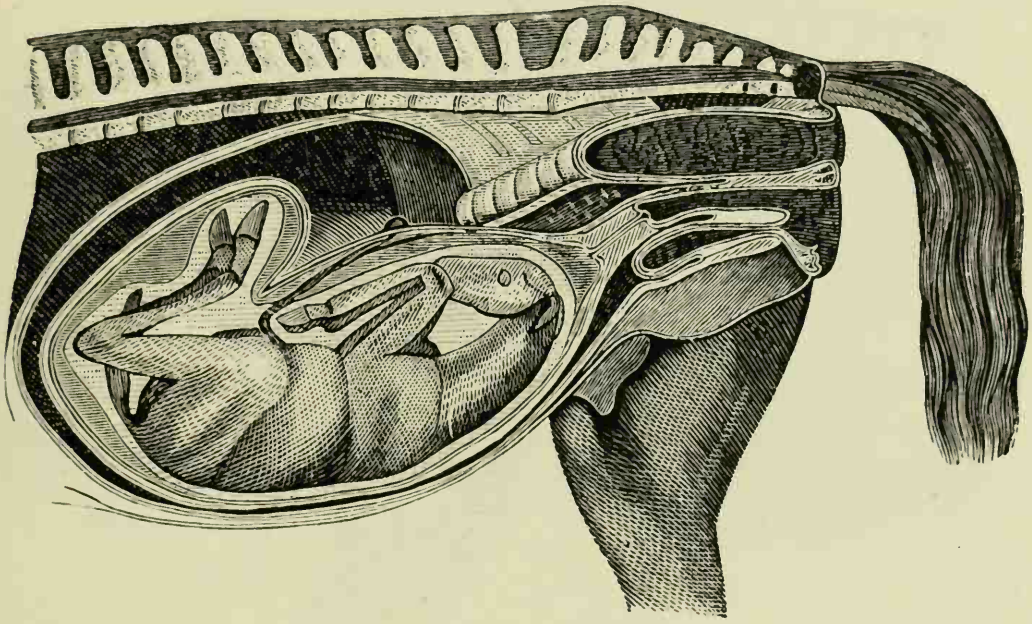

FIG. 58.—NORMAL POSITION OF THE FŒTUS IN THE MARE AT PARTURITION: FIRST STAGE. (FRANCK.)

pubis below, and the ilium at each side. The determinate points on the fœtus vary with each presentation. In designating the position of the fœtus, it is necessary to use a term indicating the name of some definite point of the fœtus in relation to some part of the pelvic inlet. Thus the vertebro-sacral position indicates that the vertebral region of the fœtus is in relation with the sacrum of the mother. The fixed points on the fœtus taken are the spinous processes of the dorsal vertebræ in the region of the withers in anterior presentation, and of the lumbar vertebræ for posterior presentation.

I. Anterior Presentation.

1. *Dorso-Sacral Position.*—The vertebræ of the fœtus correspond to those of the mother, its withers touching the sacrum of the latter, the belly corresponding to the abdominal walls, and its sternum to the pubis.

2. *Dorso-Pubic Position.*—Here the fœtus lies on its back, with its withers towards the pubis.

3. *Right Dorso-Ilial Position.*—The fœtus lies on the left side, its head to the right side of the mother, the neck being

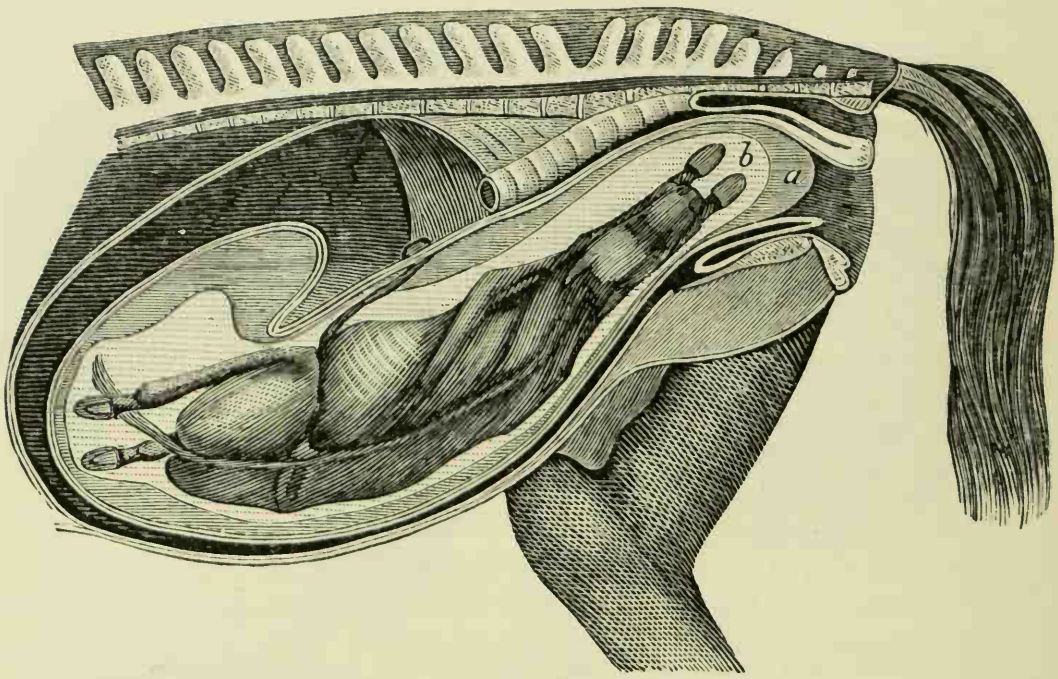

FIG. 59.—NORMAL POSITION OF THE FŒTUS IN THE MARE AT PARTURITION: SECOND STAGE. (FRANCK.)

a, Allantois; *b*, amnion.

in the same direction, and when passing through the pelvic cavity touching the left ilium. Then the sterno-dorsal diameter of the fœtus corresponds to the bis-iliac diameter, passing through the centre of the pelvis. The feet, if not in the pelvis, are directed towards the right flank of the mother.

4. *Left Dorso-Ilial Position.*—This is exactly the reverse of the last-described position, the withers corresponding to the left ilium. These two last positions are less frequent than the first two, as primary positions. Saint-Cyr also describes

other four oblique positions intermediate between the four above mentioned. These may be observed when the sterno-dorsal diameter of the fœtus corresponds to the oblique diameters of the pelvis. These are as follows :

5. *Right Dorso-Ilio-Sacral Position*, intermediate between the dorso-sacral and right dorso-ilial.

6. *Left Dorso-Supracotyloid Position*, intermediate between the dorso-pubic and left dorso-ilial position.

7. *Left Dorso-Ilio-Sacral Position*, intermediate between the dorso-sacral and left dorso-ilial.

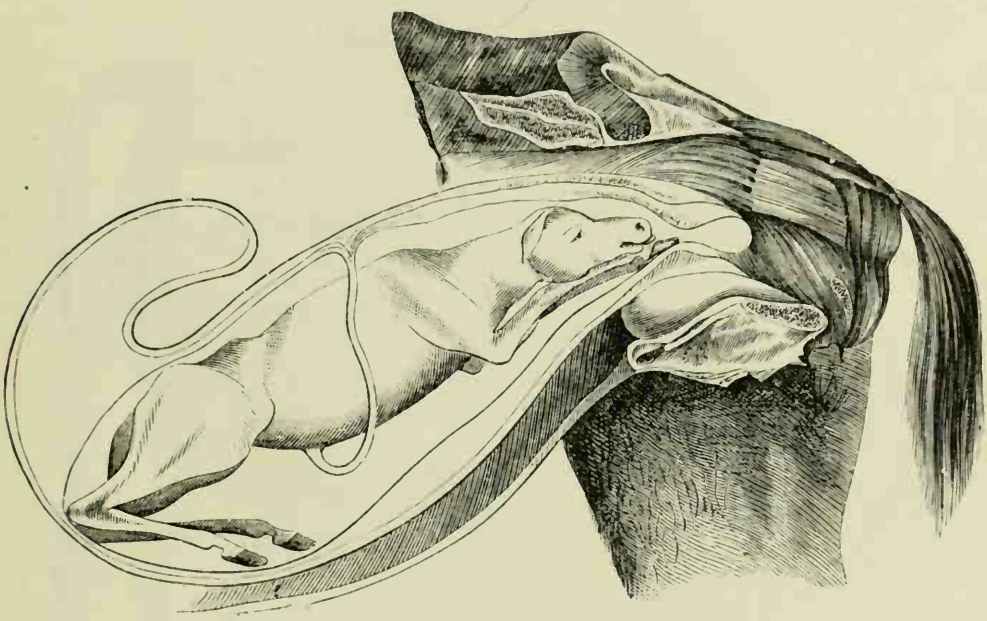

FIG. 60.—NORMAL POSITION OF THE FŒTUS IN THE MARE : THIRD STAGE—DORSO-SACRAL POSITION. (SAINT-CYR.)

8. *Right Dorso-Supracotyloid Position*, intermediate between the dorso-pubic and right dorso-ilial positions.

II. Posterior Presentation.

1. *Lumbo-Sacral Position.*—Here the loins of the fœtus are directed towards the sacrum of the mother, the right coxo-femoral articulation towards the right ilium, and the left articulation towards the left ilium.

2. *Lumbo-Pubic Position.*—The fœtus in this position lies on its back, its croup and loins corresponding to the pubis of

the mother, while the limbs are towards the sacrum, against which they are more or less pressed.

3. *Right Lumbo-Ilial Position.*—The fœtus is lying on the right flank, its croup and loins opposite the ascending branch of the right ilium of the mother, and the limbs towards the left flank, where they must be sought for if they do not present in the pelvis.

4. *Left Lumbo-Ilial Position.*—This is exactly the reverse of the preceding position.

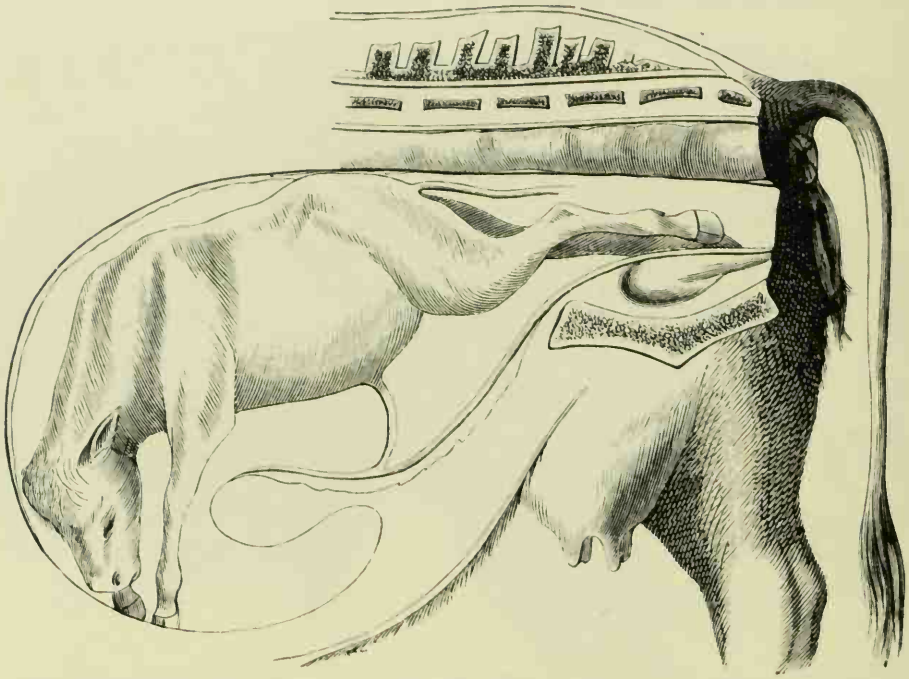

FIG. 61.—LUMBO-SACRAL POSITION. (SAINT-CYR.)

5. *Right Lumbo-Ilio-Sacral Position.*—This is intermediate between the lumbo-sacral and the right lumbo-ilial positions, the lumbar region being towards the right sacro-iliac articulation.

6. *Left Lumbo-Supracotyloid Position.*—This is also intermediate between the lumbo-pubic and the left lumbo-ilial position, being the reverse of the preceding.

7. *Left Lumbo-Ilio-Sacral Position* is intermediate between the lumbo-sacral and left lumbo-ilial positions.

8. *Right Lumbo-Supracotyloid Position* is the opposite of the preceding.

III. Dorso-Lumbar Presentation.

Here the fœtus is presented across, and it may lie on one or other of its sides, its head towards one of the maternal flanks, and the body curved like that of a dog asleep. The determinate point of the fœtus to be considered in this

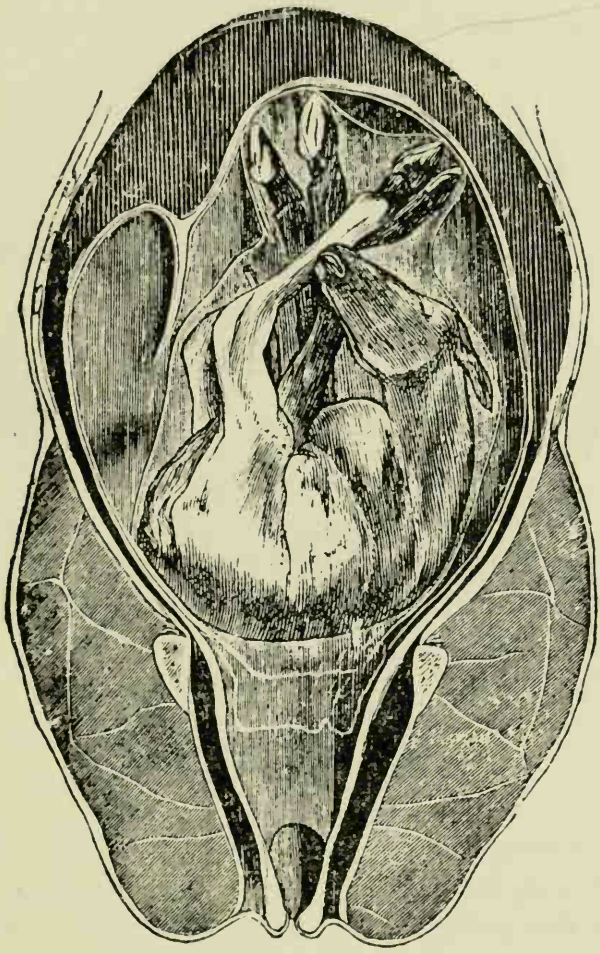

FIG. 62.—RIGHT CEPHALO-ILIAL POSITION IN THE DORSO-LUMBAR PRESENTATION. (FRANCK.)

presentation is the head. The three following positions are described :

1. *Right Cephalo-Ilial Position.*—The fœtus is on its right side, which rests more or less directly on the abdominal walls of the mother, the head in the right flank, the croup towards

the left flank, the body more or less curved, and the dorso-lumbar region towards the pelvis.

2. *Left Cephalo-Ilial Position.*—This is the reverse of the preceding.

3. *Cephalo-Sacral Position.*—The fœtus presents by its back and in an almost vertical attitude, the croup resting on the floor of the abdomen, the head more or less depressed and directed forwards towards the sacro-lumbar region, the creature being seated, as it were, on the udder of the parent.

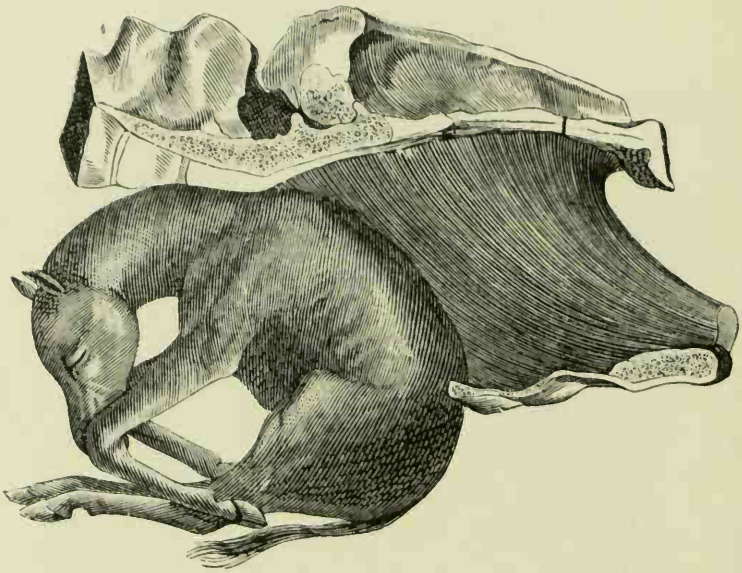

FIG. 63.—CEPHALO-SACRAL POSITION IN THE DORSO-LUMBAR PRESENTATION. (SAINT-CYR.)

IV. Sterno-Abdominal Presentation.

In this transverse presentation the fœtus offers the abdomen to the inlet of the pelvis, and on deep exploration the hand first meets this part, and perhaps two or more limbs, generally a hind and a fore one. The head may be found or may be out of reach; or the head and limbs may be doubled back, so that no part of the creature has entered the vagina, and other parts on the lower surface of the body may be felt.

In this presentation there are three principal positions:

1. *Left Cephalo-Ilial Position.*—The fœtus lies on the right side, the head towards the left ilium of the mother, and the croup towards the right ilium.

2. *Right Cephalo-Ilial Position.*—This is the reverse of the left cephalo-ilial position.

3. *Cephalo-Sacral Position.*—In this position the fœtus is vertical, the croup being downwards; but the abdomen and sternum are towards the pelvic inlet, all the limbs being directed towards the os uteri, while the withers correspond to

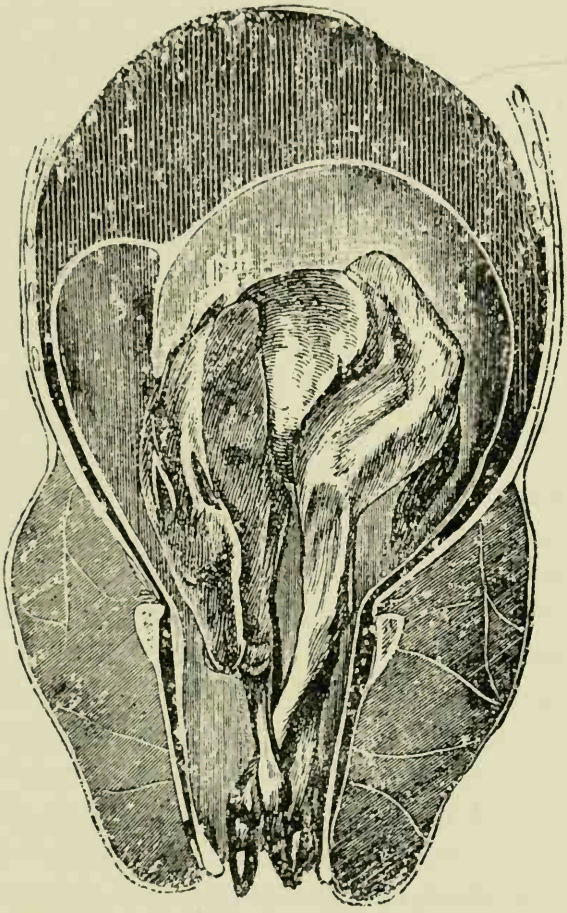

FIG. 64.—LEFT CEPHALO-ILIAL POSITION IN THE STERNO-ABDOMINAL PRESENTATION. (FRANCK.)

the sacro-lumbar region, and the head is turned to the back or sides of the fœtus.

A study of the above positions enables one to give a more accurate description of normal and abnormal presentations and positions, and of the best means of overcoming the latter difficulties. The following table shows at a glance the different presentations and positions (according to Violet):

- Presentations.
  - Longitudinal
    - Anterior
      - Dorso-sacral.
      - Right Dorso ilio-sacral.
      - Left Dorso-ilio-sacral.
      - Right Dorso-ilial.
      - Left Dorso-ilial.
      - Right Dorso-supracotyloid.
      - Left Dorso-supracotyloid.
      - Dorso-pubic.
    - Posterior
      - Lumbo-sacral.
      - Right Lumbo-ilio-sacral.
      - Left Lumbo-ilio-sacral.
      - Right Lumbo-ilial.
      - Left Lumbo-ilial.
      - Right Lumbo-supracotyloid.
      - Left Lumbo-supracotyloid.
      - Lumbo-pubic.
  - Transverse
    - Dorso-lumbar
      - Right Cephalo-ilial.
      - Left Cephalo-ilial.
      - Cephalo-sacral.
    - Sterno-abdominal
      - Right Cephalo-ilial.
      - Left Cephalo-ilial.
      - Cephalo-sacral.

MECHANISM OF PARTURITION.

As mentioned on p. 106, during the later stages of pregnancy, the fœtus of the mare lies on its back with its limbs flexed, its neck bent and mouth touching the breast (see Fig. 58). Before birth the fœtus is rotated on its long axis by the muscular action of the uterus so that it successively turns on its side (see Fig. 59), and later, its back is directed upwards. The limbs become extended through the fœtal movements. In the cow, the body of the fœtus appears towards the end of gestation also to lie on one side, and preparatory to parturition rotates on its long axis as in the mare. Failure to effect these changes may act as a cause of difficult parturition.

Of the different presentations enumerated, the anterior, with the dorso-sacral position, in which the fore-feet and head present simultaneously, is the only one which we may call "natural," especially with the larger animals and primiparæ.

At the same time birth often requires no assistance when the presentation is posterior and the hind-limbs are presented. In the mare, however, it very often entails the death of the foal.

Mare—Anterior Presentation.

1. *Mechanism of Parturition in the Dorso-Sacral Position.*—In this position, when perfectly natural, the head and fore-legs first enter the pelvic inlet; the head is extended, the forehead looking up towards the sacrum, chin towards the pubis, nose forwards, the lower jaw resting on the outstretched limbs, the feet of which extend a little beyond the nose. Then comes the neck, and after it the chest and shoulders, which arrive at the inlet when the nose and feet show themselves at the vulva. The head and limbs present no difficulty for their passage, as the pelvic diameters readily admit them when the soft parts are sufficiently relaxed. The diameter of the chest of the fœtus is, however, greater than that of the pelvis. In normal parturition the biscapulo-humeral diameter of the fœtus is less by $1\frac{1}{2}$ to 2 inches than the bis-iliac diameter of the female pelvis, while the sterno-dorsal diameter of the young creature exceeds that of the sacro-pubic diameter of the mother's pelvis by 1 to $3\frac{1}{2}$ inches (Saint-Cyr). The chest of the fœtus must undergo a decrease in size, and especially in its vertical diameter, before it can clear the inlet. For this purpose the dorsal spines, which are almost cartilaginous, bend backwards. The withers first enter under the sacrum, and the sternum below is pushed back by the anterior border of the pubis, and the chest in this way submits to a process of elongation which notably diminishes the vertical diameter of the chest. The shoulders of the fœtus also, on arriving at the pelvic entrance, come in contact with the ascending branches of the ilium, and are thrown back somewhat, leaving the anterior portion of the chest free, and so diminishing its diameter.

In the larger animals the pelvis cannot undergo any sensible increase in size during the passage of the deepest portion of the fœtal body through the inlet—in the mare an absolute inextensible bony girdle. Lafosse has sawn through the pubes of mares about to foal, and he found during parturition that there was only a space of two lines between the sawn margins, so that it is the body of the fœtus which has to accommodate itself to this part of the passage at this stage of delivery.

Behind the inlet the pelvic canal may be enlarged by the extensibility of the maternal tissues. The sacro-sciatic ligaments are softened and more elastic during birth, the sacro-iliac and sacro-lumbar articulations are increased in mobility, and even the posterior part of the ischio-pubic symphysis may be slightly relaxed. Hence, when once approaching the outlet, the progress of birth is more rapid, and may be aided by the elevation of the tail of the mother.

A slight check to expulsion is observed when the croup arrives at the inlet, as this part nearly corresponds in diameter to this opening. Here occasionally friction occurs, especially if the croup is largely developed. One haunch may pass into the inlet before the other, and thus facilitate the passage.

2. *Mechanism of Parturition in the Dorso-Ilio-Sacral Position.*—These positions are two in number and symmetrical, and probably are frequent at the commencement of birth in the anterior presentation, when the width of the pelvis exceeds its depth—the oblique diameters being even greater than the vertical—so that the fœtal thorax enters even more easily, and it is only when the croup reaches the inlet that the fœtus is compelled to rotate slightly on itself to assume the first position on its passage outwards; when the depth of the pelvis is greater than its width, this rotation is effected spontaneously at the commencement of birth, so that these oblique positions are as favourable as the dorso-sacral position.

3. *Mechanism of Parturition in the Dorso-Ilial Position.*—These lateral positions, also two in number, are rarely primary, but are sometimes found as secondary positions, due to the reduction of some malpresentations. They are usually difficult, even although the bis-iliac diameter of the mare be equal to the sacro-pubic. The dorsal spines sometimes become jammed against the ascending branches of the ilia. If the pelvis is sufficiently wide and the fœtus small, the latter may rotate so that its greatest diameter may be brought opposite to the oblique diameter of the inlet, and its expulsion easily effected. If the pelvis is narrow, the position must be changed to the oblique or dorso-sacral before birth is possible. Frequently aid is necessary to effect delivery when the fœtus lies in this position.

Posterior Presentation.

Mechanism of Parturition in the Lumbo-Sacral Position.—The only position in a posterior presentation compatible with a spontaneous delivery is the lumbo-sacral. The loins of the fœtus are directed towards the sacrum of the mother, the hind-limbs are in complete extension and enter the inlet, so as to open the passage for the body. This presentation is not so common in the mare as the anterior presentation, and the position is far less favourable than the first anterior position. The croup of the fœtus does not admit compression, and its diameters are nearly equal to those of the pelvis. Its upper part presses against the sacro-vertebral angle, while the prominent stifles present against the edge of the pubis, and the hip-joints against the shafts of the ilium. Entrance of the fœtus into the pelvis is therefore slow and difficult, and when effected the chest has to follow, and is compressed, as in the anterior presentation. But there is a tendency to erect the dorsal spines, and to carry the ribs and sternum forwards, and so increase the diameter of the fœtus. When the fœtal fluids have escaped, and the passage becomes dry, the set of the hair of the fœtus may adversely affect the passage of the fœtus. Under other conditions it is hardly likely to prejudice birth to any appreciable extent. In this case the young creature incurs the greatest danger. Labour is more likely to be successful, and less tedious, if the haunches of the fœtus present one after the other at the inlet.

Cow—Anterior Presentation.

The mechanism of parturition in this case is similar to that in the mare. The principal difficulty is experienced by the fœtal thorax, which is slightly larger in every sense than the inlet.

The bicoxo-femoral diameter of the croup slightly exceeds the bis-iliae diameter of the pelvis; but possibly the pelvis of the calf, being more cartilaginous and supple than that of the foal, may be submitted to a slight temporary compression.

The progress of the calf through the pelvis is more protracted than that of the foal, owing to the great length of the

maternal ischio-pubic symphysis and the more considerable extent of the pelvic walls, as well as the peculiar curve in the floor of the pelvis. The various positions in this presentation do not differ much from those in a mare with a narrow pelvis.

The same may be said of the positions in the *posterior presentation*. In the lumbo-sacral position the calf is more frequently born than the foal, because the stifles of the calf are more oblique, and are not so liable to be held by the anterior border of the pubis, and the femurs are not much longer than the sacro-pubic diameter. The cow is more rarely subject to injury, and more frequently calves spontaneously, when the calf is in this position.

The Smaller Animals.

In a general way, the same remarks are applicable here to presentations and positions as in the case of the mare and cow

In the sheep and goat especially, similar modifications occur in the fœtus, when single, during parturition. In multiple gestation the dimensions of the young animals are frequently less than those of the pelvis, and parturition is therefore comparatively easier. The latter is nearly always the case with the sow, and even more frequently with the bitch and cat. In the bitch, in the anterior presentation, the fore-limbs of the fœtus are frequently placed alongside the thorax in traversing the pelvis. The head of the fœtus is even more voluminous than the chest, and is not nearly so compressible. The head presents usually the most serious obstacle to parturition, especially when it is not only large, but the muzzle short. The posterior presentation is frequent in carnivora, and offers no special difficulty.

NECESSARY AID IN NORMAL PARTURITION.

As a rule, parturition is generally effected in animals in a spontaneous manner, and without danger or prejudice to the mother or offspring. But because of the unfavourable consequences sometimes noted, certain precautions should be observed with animals, especially if they are valuable and artificially kept. The nearer to the state of nature the

animals are kept, the fewer are the precautions necessary to be taken. An animal tied up in a stall among the animals of the same or different species is more exposed to accidents than one which is in a place by itself, or which is at liberty in pasture or meadow. Probably the open field is the best place in which any of the herbivora may give birth to their progeny when the weather is favourable; but the objection to it is that, if any difficulty arises during the act, it will not come under observation for some time afterwards. If the animal is housed, the mare about to foal should be allowed a perfectly clean, roomy loose-box, well supplied with soft litter; and the cow should, if possible, be similarly provided. If either animal must be kept tied, owing to want of other facilities, then the fastening should be of such a kind that it can readily be undone when required. The sow should have a separate sty, and even the sheep may need a separate allotment. When the female is kept in a dwelling, the temperature should be comfortable and the ventilation good. During labour the animal should be allowed perfect quietude; and if the light of the stable is too bright, it may be partially excluded. A trustworthy person should keep it under observation, in order to avoid accidents; but he should keep himself out of sight, and meddle with the animal as little as possible. Some creatures, and particularly mares, are rendered peevish and fidgety if they see anyone present during parturition, and this process is interfered with. Unless something irregular or abnormal occurs during this act, all should be left to nature. The irregularities consist chiefly of hurried and protracted parturition, being only modifications of natural labour, and the difficult cases coming under the heading of dystokia.

Whether called into a case of irregular or abnormal parturition, the first care of the veterinary surgeon will be to assure himself as to the state of the animal and the progress made in the act. Under natural circumstances the labour pain should be normal, and the act should neither be hurried nor yet too slow; and the mother should not exhibit any constitutional weakness or physical debility. The preparatory labour pains must not be mistaken for real expulsive efforts. When the genital structures and the pelvis appear to be

normal, and the course of parturition remains normal, nothing should be done under ordinary circumstances. It is only when obstacles, insurmountable by the natural efforts of the animal, offer themselves that aid must be rendered.

With the mare, however, delay should not be pushed too far, as the fœtal placenta is very easily detached from the uterine surface, and the fœtus may die of asphyxia or inanition. So quickly does the latter take place, that it is very seldom that the veterinary surgeon, in dealing with a difficult parturition in the mare, delivers a live foal because he is not called in or does not arrive at the case early enough. If, after expulsive efforts have been active for a quarter of an hour in the mare or two or three hours in the cow there is no apparent progress, then it is necessary to make an examination of the uterus and fœtus through the vagina. For this purpose the hand and arm must be clean, lubricated, and antisepticized, to prevent infection of the genital tract. In addition, the under aspect of the tail and the skin around the vulva should be carefully washed with soap and water and afterwards dressed with an antiseptic solution. The time chosen should be the interval between the pains, and the exploration may be made while the animal is standing or lying, the former for convenience to the operator. Care must be taken not to rupture the membranes if still intact. In the bitch and cat the finger only can be used for exploration.

By this examination it can be easily ascertained if the pelvic and genital passages are normal, whether the os is opened or constricted, whether the fœtus is normal, alive, and natural in form and size, and in such a position that it can be expelled without assistance. If the act of parturition is not advanced, and the fœtal membranes are intact, and the soft parts through which the fœtus has to pass are not enough dilated, time ought to be permitted for this to take place If this is accelerated by the intervention of art, accidents are more likely to occur.

The intelligent owner of, or attendant on an animal which is about to bring forth should be able to ascertain the position of the fœtus; but if there is anything apparently abnormal, he should not attempt to deliver the animal himself, as he

may only aggravate the accident and render relief more difficult. The skill of the veterinary surgeon should be applied to the case as early as possible, in order to preserve, not only the mother, but also the offspring. Often the veterinarian is not appealed to until great damage has been done by the owner, his servants and neighbours, or the empiric, and valuable time lost. The case then may be one of extreme difficulty or hopelessness from exhaustion or injury.

Uterine Inertia.

Occasionally protracted labour, where all the appearances are otherwise normal, is observed in emaciated, puny, and frequently old animals, which are debilitated from lack of a sufficient or nutritious diet, from prolonged lactation or overwork, or are worn out by chronic wasting disease. It may also, but rarely, be due to congenitally feeble development of the uterine muscular fibres, and to diminished contractility of these by overdistension of the uterus during pregnancy. The inertia may be primary or secondary. In the first form the labour pains are feeble from the beginning, while uterine inertia when secondary occurs at a later stage because of undue delay in parturition or following upon much manipulation. The symptoms are frequent and comparatively shallow inspirations, feeble and infrequent straining, weak pulse, restlessness, and other symptoms of suffering and extremely slow progress in birth. The uterine contractions will be found to be weak if an examination be made through the vagina. The os is often more or less dilated. It is not uncommon in the bitch, sow, and ewe, is occasionally noted in the cow, and is rare in the mare.

The great danger of this affection is that the fœtus may die as the result of detachment of the placenta and become emphysematous. This is a frequent cause of mortality among ewes.

Such cases should be given time, and stimulants, such as strychnine, ammonia, or alcohol, should be administered. Pituitrin has come into general use as a valuable stimulant to the muscular wall of the uterus, where there is no obstruction and the os uteri is dilated. It is given by intramuscular

injection in doses of ½ to 1 c.c. for the bitch, and may be repeated two or three times at hourly intervals. The bowels and bladder, if full, should be emptied prior to injection. Harvey prefers quinine as a direct stimulant and tonic to the uterus. He recommends quinine for the ewe and cow, and states that pituitrin, on account of the violence of its action, may be responsible for rupture of the uterus if there is any obstruction to delivery.

Sometimes after this treatment birth takes place spontaneously, but it may be necessary to assist delivery by moderate and judicious traction on the fœtus when the mother makes expulsive efforts. If the membranes have ruptured and the fluids have escaped and the mucous membrane of the uterus and vagina has become dry—*i.e.*, in secondary inertia—lubricating fluid such as infusion of linseed should be introduced to facilitate the passage of the fœtus before any assistance is given. In some cases in the bitch a drive in a car or even causing the animal to run up and down stairs will start the delayed birth.

Death of the Fœtus.

When parturition is retarded, it is often necessary to ascertain whether the fœtus is dead or alive. This is by no means always easy. So long as the fœtus displays active movements, it is alive; but the absence of these is not absolute proof that it no longer lives, for sometimes, when it is partly in the pelvis, and the waters have escaped, so that the uterus encloses it firmly, though still living, it remains passive, and cannot be stimulated to movement. Should the presentation be anterior, then passing the fingers into its mouth and titillating the tongue will prove a test of its vitality, as the jaws and tongue are most certain to move if it lives; but the absence of movement will not be decisive, though it will constitute very probable evidence of death. If the umbilical cord can be reached and seized between the thumb and index-finger, slight compression will discover whether or not the arteries pulsate. The absence of pulsation is strong presumption that the fœtus is dead.

The coldness of the parts of the fœtus external to the vulva

of the mother, when well marked, is also a sign of death. The fœtor of the liquor amnii is also indicative of death. When decomposition has, however, well advanced, and the fœtus is emphysematous and its hair easily removed, then there can be no doubt as to its being dead. Frequently the expulsive efforts cease for a time if the fœtus is dead within the uterus; but if it has passed into the pelvic inlet, the pains continue as usual. In the cow the fœtus may be alive, though the labour pains have ceased for some hours, or only occur at long intervals. In the bitch, when the pains are weak, the first puppy that presents is usually dead.

The *Causes of the Death of the Fœtus* are—

1. Knots and twists on the umbilical cord, extremely rare in the domesticated mammals because of the shortness of the cord.

2. Prolonged compression of the umbilical cord, due to the fœtus remaining a long time in the passage, whereby the circulation of the blood is checked.

3. Premature rupture of the fœtal membranes and total escape of the liquor amnii, which, if parturition is not soon completed, exposes the fœtus to great danger of immediate pressure of the uterus upon it.

4. Disunion between the uterus and fœtal envelopes, by which the vital connection between the mother and fœtus is interrupted; and if the latter is not quickly expelled, it must die from asphyxia. Owing to the difference in the placentation of the different animals, it is not equally common in all.

The foal as a rule does not live in the uterus of the mare for more than three or four hours, often less, after the first expulsive efforts; while the calf in the same condition can live much longer, sometimes for several days, after the commencement of labour.

The fœtus may also perish when it is in the wrong position, or is of unusual size, and force has to be employed in delivering it, in which case undue compression of the chest may impede the action of the heart.

Death of the fœtus does not of itself interfere with delivery, until it is followed by some rigor mortis or emphysema. It has been thought that the dead fœtus does not stimulate the contractions of the uterus.

Probably the chief action which a living fœtus has in aiding parturition is to rectify trifling irregularities in presentation or position by its automatic or more or less instinctive movements.

Rupture of the Water-Bag.—As a rule this may be left to Nature. In the mare it occasionally happens that the foal is born without rupture of the fœtal membranes, and may be in danger of asphyxia. In such a case it is necessary to incise the membranes as soon as the foal is born, so as to avert that accident. This is never necessary in the cow.

When the fœtal membranes rupture too early, the uterus contracts on the fœtus and the genital passage becomes dry and adherent, and these conditions are opposed to birth. In this case artificial lubricants must be introduced into the genital passage.

Traction of the fœtus in normal birth is not called for when the animals are in a state of nature. But under artificial conditions, and when the mother is a primipara—as, *e.g.*, a heifer—or is old and feeble, some assistance is required. Traction in these cases should be slow and moderate, and only applied to supplement the expulsive efforts of the animal. The simplest and safest traction is that made by the hands of the operator, so as to avoid injury both to mother and fœtus. In the dorso-sacral position, gentle traction may be made on the pastern of each fore-leg when these and the head have cleared the vulva. The direction of the traction should be obliquely downwards and backwards towards the hocks of the mother, so as to allow the body of the fœtus to follow the curve of the pelvis; inclining the traction a little to the right and left will also aid in passing the shoulders, and afterwards the haunches. If the fœtus is in the dorso-ilio-sacral position, the feet while in the vagina should be prevented from pressing against the sacrum, and brought gently outside the vulva along with the head. Then traction may be employed, and should first be upwards and backwards, so as to clear the withers from the brim of the pelvis, against which they sometimes jam. When this is effected, the same procedure as in the other case is to be adopted.

In the dorso-ilial position, if recognized in time, the attempt

should be made to convert into the dorso-sacral position before the chest enters the pelvis. If the fœtus is already in the passage, the feet should be guided outside the vulva, and then the forearm is seized, and used to turn the withers towards the sacrum of the mother. Moderate traction is afterwards employed on the limbs. If the fœtus presents posteriorly, in the lumbo-sacral position, expulsion must be hastened as soon as the body enters the pelvic canal, because of the danger to the life of the fœtus from pressure on the umbilical cord. If employed in the early stages, the traction on the hind-limbs is directed upwards and backwards in order to carry the stifles over the brim of the pubis, which sometimes checks them; then downwards to bring the croup below the sacrum; and lastly an alternate movement from left to right and right to left, to free the haunches one after the other.

In the lumbo-ilio-sacral and lumbo-ilial positions, the fœtal croup passes along easily, when the pelvis is deeper than it is wide—as in the cow. The limbs only need careful direction through the vagina; and when the croup has entered the pelvic cavity, the body should be so rotated as to bring the large diameter of the chest to correspond with the vertical diameter of the inlet

Gemellar pregnancy is not usually recognized in uniparous animals until birth takes place. The escape of only a small quantity of liquor amnii, and the small size of the creature first delivered, when compared with the size of the mother's abdomen, are not infallible indications that more young will be produced. Usually the fœtuses present in succession and no assistance is required. Rarely two fœtuses present at the same time, and neither can come through. Then it is necessary to push back the one least favourably presenting, and to keep it away until the fore or hind limbs of the other are engaged in the passage. Although this is but a rare occurrence, it impresses one with the importance, at a vaginal exploration, of making certain that the parts presented belong only to one fœtus.

After Labour.

When the parturition has been normal, simple hygienic measures are all that are necessary. The mother must be kept quiet, comfortable, with plenty of fresh air. If the mare is perspiring, she should be well wisped, and if necessary a blanket applied. A gallon or so of nourishing tepid gruel may be given to the mare or cow. Clean dry litter should be plentifully supplied. Afterwards the young may, if necessary, be assisted to the teat. The fœtal membranes should be got rid of, and any discharge on the tail and thighs of the mother washed or wiped away. Afterwards the diet should consist of grass, mashes, etc. For the working mare, from three to eight days' rest should be allowed to permit of complete recovery.

In protracted parturition, where there is a likelihood of injury to the genital passages, the latter should be flushed out with sterilized water, or normal saline solution, or a weak, non-irritant antiseptic lotion, such as contains boric acid or potassium permanganate, to prevent metritis or metroperitonitis. Where debility results, stimulants should be administered. When turned out to pasture, the animals should be afforded protection in bad weather.

With regard to ewes, if the weather is mild and the situation favourable, protection is not required. When more than one lamb is likely to be produced, the first should be kept warm and receive a little cow's milk diluted with water until the ewe has finished lambing. Twin lambs may easily be reared by a strong mother; but as a rule, if there are more than two, the extra lambs should be put to another ewe or reared artificially. In order to overcome the repugnance so often manifested by the ewe to a strange lamb, if its own has died, the foster-lamb may be covered or rubbed with the skin of the dead creature, or the two may be placed together during the night, or even put into a dark shed along with a dog, which will induce the ewe to protect and take to the lamb. The same care is necessary for the goat.

The sow generally suffers from weakness and prostration after parturition, and requires plenty of nourishing and easily-digested food. When this is given, there is less likelihood of

the animal devouring its young, and especially if it is not irritated by the presence of people.

The bitch should not be allowed to rear too many puppies; and warmth, a dry abode, and good food, must be allowed. A prospective foster-mother does not readily take to strange puppies; sprinkling these with some of its milk has been sometimes successful. In cases where a foster-mother cannot be obtained, an artificial one, consisting of a bottle with projecting teats, is used. The milk is introduced to the bottle, and the puppies soon learn to remove the milk by sucking the teats. Constipation is not infrequent after parturition, and this may be removed by a laxative, such as castor-oil or syrup of buckthorn.

Attention to the Offspring.

The fœtus must, if born in the fœtal membranes, be freed from them to prevent asphyxia. If the umbilical cord is not ruptured, it should be ligatured with an antiseptic cord about 2 inches from the umbilicus, and then the distal end cut through, or it should be severed by scraping. Frequently the young creature is born in a state of *suspended animation or syncope*, and at first gives no sign of life. Especially is this the case with calves after protracted labour. The life of the animal should not be despaired of until certain attempts have been made to stimulate respiration. The mucus must first be removed from the mouth and nostrils. The young animal should then be raised up with the hind-limbs and thrown on one side and then on the other, and the movement repeated several times if necessary. Other methods of stimulating respiration consist in pulling out the tongue, blowing air into the nose with a pair of bellows, moving the fore-limbs to bring about artificial respiration, applying friction to the body with wisps of straw, and dashing cold water on the fœtus. Sometimes these efforts are followed by a gasp on the part of the animal, or a cough, indicating the onset of respiration.

With the larger animals, the newly-born creature should be placed before the mother, if not near her. She generally licks off the viscid matter covering its skin, and, if she does not

do so at once, may be stimulated to do so by sprinkling a little salt over the fœtus. The fœtus becomes revived, and soon endeavours to get up; and though it may fall several times, yet it generally quickly succeeds in maintaining itself on its limbs, and instinctively seeks the maternal teat. Should the mother not lick its offspring, then the latter must be well dried and rubbed with a sponge, hay-wisp, or cloth. This is more particularly necessary when the mother is indifferent to it, which sometimes happens with primiparæ when people are present.

If the foal or calf is weak, and cannot reach the teat in half an hour or so after birth, it is necessary to assist it by bringing it to the mother and applying the teat to its mouth, at the same time caressing and soothing the parent, if disinclined to it by temper or by painfulness of the udder. Sometimes it is necessary for an attendant to hold the mare by the head or lift up its fore-foot. In other cases the tying of the mare is sufficient to cause her to become reconciled to the foal, and for the latter to find its way of its own accord to the udder.

When the foal exhibits great debility, it may be preferable to feed it for a day or two with the milk of the mare which has been drawn by hand. Occasionally a mare that has lost its foal may be got to act as a foster-mother. It is exceedingly difficult to rear a foal artificially on cow's milk.

With the cow there is very little difficulty. The calf may be reared with the cow, or may be artificially reared, as found convenient.

Lambs when able to stand, and if they do not readily find their way to the teat, should have a little milk from it pressed into their mouth. If the ewe has not sufficient milk, the latter may be increased to some extent by a liberal supply of good food.

Multiparous animals, such as the bitch and sow, usually lie when suckling their young, so that there is seldom any difficulty with them. The only care generally required in the case of young pigs is to prevent their being crushed by the sow in the act of lying down or moving. It is well to remember that, if a sow has more young than teats, the weakest will die of starvation. Each young pig has its own

particular teat, to which it is persistently attached; and if the creature is ill and does not suck, and if there is not a claimant for the teat, the gland there will cease secreting milk. The pectoral teats and glands are the largest and most active, and the weakest of the litter should be put to them. In general, a sow should not be allowed to rear more than ten in a litter. Cleanliness and warmth are required for young pigs.

Puppies do not require any special care beyond a warm, clean, and dry abode.

At the first examination of the young animal, care should be taken to ascertain that all the natural openings are patent, and, if not, to render them so by incision or puncture.

After the first milk has been taken, there is usually an abundant evacuation of yellow-brown very adhesive matter—*meconium*—from the intestines of the young animal. This evacuation is brought about by the colostrum; and if it does not occur, serious constipation may ensue. With new-born animals which are deprived of this colostrum, a mild laxative, such as castor-oil, should be administered to avoid the constipation.

The young with their parents should be kept apart from others—for some time at least, and especially the equine species.

Gentle exercise is as necessary for the foal and calf as it is for their parents, a few days after birth. Therefore a meadow is preferable to a stable. With the mare, light and regular work may be imposed a short time after foaling, and in some cases, if the journey is short, the foal may be allowed to travel in company.

SEQUELÆ OF PARTURITION.

1. *After-Pains* are due to contractions of the uterus that persist for some time after expulsion of the fœtus and fœtal membranes, in order to reduce the volume and cavity of the uterus. They are not very noticeable in the domesticated animals. After an easy labour there are generally few or no symptoms of these pains; and when they are present, the only indications are whisking of the tail, at which time the walls of the abdomen appear to be harder. If the animal

exhibits marked suffering and strains frequently for more than two hours in the mare, or twenty-four hours in the cow, then one may suspect the retention of a portion of the fœtal membranes in the uterus, or commencing inversion of that organ, and proceed to make a vaginal exploration to ascertain the cause. In cases where retention of the fœtal membranes or commencing inversion of the uterus is found, the treatment must be applied as recommended later on for these conditions.

2. *Lochia.*—This term is given to the sanguinolent, serosanguinolent and mucous evacuations from the vagina occurring after parturition. This discharge consists of blood, débris, and mucous secretions, from the uterus. It is considerably less than in woman, and escapes at irregular periods, chiefly during defæcation and micturition. For the first few days it is sanious, and later becomes mucous, but never fœtid when normal. In the larger animals this discharge can be seen about the inferior commissure of the vulva; it sometimes accumulates about the thighs and tail in flakes and patches, as well as on the litter; and when the animal has been lying, it forms small pools on the ground. The mucous discharge may continue for more than a week after parturition. Sometimes the sudden cessation of the lochia is followed by dulness, inappetence, suppression of milk, slight fever, and constipation. To avoid this, the animal should be well fed and cared for, not subjected to fatigue or severe weather.

3. *Lactation.*—Before parturition, preparation for the secretion of milk is already being made in the mammary glands, and immediately preceding that event a thin serous or milky fluid can often be expressed from the teat; while immediately after delivery the œdematous tumefaction which had been observed in these glands for some time begins to disappear as they increase in volume, become firmer, tenser, and more sensitive, and receive a large quantity of blood. Then their activity is suddenly brought into full operation, and their secretion reaches its maximum.

The first milk secreted for the first day or two is called "colostrum," and differs much from the milk secreted afterwards.

Colostrum is a viscid, dirty white or yellowish fluid, sweet though unpleasant to the taste, and of greater density than that of ordinary milk, being in the cow 1056. When allowed to stand for some time it has a thick layer of tough cream; it coagulates at a comparatively low temperature into a semi-solid mass, due to the presence of albumin. It is very rich in solid elements; the fat globules present are numerous but small; and it contains large numbers of colostrum corpuscles, derived from the epithelial cells filling up the acini of the gland before birth, and many leucocytes. These are under-

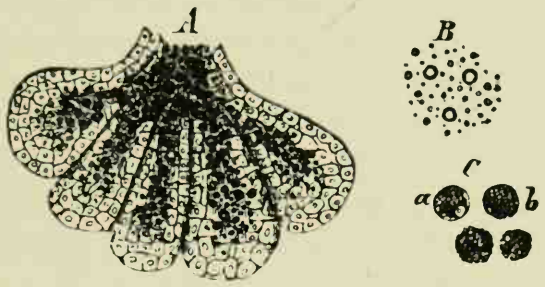

FIG. 65.—MAMMARY GLAND DURING LACTATION.

A, Lobule of the mammary gland filled with cells; B, milk or fat globules; C, colostrum; *a*, cell filled with fat granules and with a visible nucleus; *b*, cells from which the nucleus has disappeared.

going degeneration. The casein in the milk is small in quantity.

Dumas gives the analysis of colostrum of various animals as below:

	Cow.	Ass.	Goat.
Water	803·3	828·4	641·0
Fat	26·0	5·6	52·0
Albumin	150·7	116·0	245·0
Mucus	20·0	7·0	30·0
Sugar	traces	43·0	32·0

Milk.—Towards the fifth or sixth day, or even longer, after parturition in the cow and mare, earlier with some of the other animals, the colostrum disappears, and then we have the ordinary milk. This is an opaque, pure white or slightly yellowish fluid, possessing a sweet taste, and a faint odour somewhat resembling that of the animal from which it is

obtained; unctuous to the touch; varying in density from 1032 to 1041, according to species and other circumstances; generally alkaline in herbivora, acid in carnivora. It contains chiefly water, butter, casein, but also albumin, milk-sugar, and mineral matters.

Vernois and Becquerel give a comparative table of the composition of the milk of various animals, as below:

	Woman.	Cow	Goat.	Sheep.	Camel.	Mare.	Ass.	Sow.	Bitch.
Specific gravity ..	1032·67	1033·38	1033·53	1040·98	—	1033·74	1034·57	—	1041·62
Weight of water	889·08	864·06	844·90	832·32	—	904·30	890·12	854·90	772 08
Weight of solid parts	110·92	135·94	155 10	167·68	134·00	95·70	109·88	145·10	227·92
Fat	26 66	36·12	56·87	51·31	36·00	24·36	18 53	19·50	87·95
Casein and extractive matters ..	39·24	55·15	55·14	69·78	40·00	33·35	35·65	84·50	116·88
Milk - sugar	43·64	38·03	36·91	39 43	58·00	32·76	50·46	30·30	15·29
Salts ...	1·38	6·61	6·18	7·16	—	5·23	5·24	10·90	7 80

Doyère gives the following analysis:

Constituents.	Woman.	Cow.	Goat.	Sheep.	Llama.	Ass.	Mare.
Water	87·38	87·60	87·30	81·60	86·60	89·63	91·37
Fat	3 80	3·20	4·40	7·50	3·10	1·50	0·55
Casein	0·34	3·00	3·50	4·00	3·00	0·60	0·78
Albumin	1·30	1·20	1·35	1·70	0·90	1·35	1·40
Sugar	7·00	4·70	3·10	4·30	5·60	6·40	5·50
Salts	0·18	0 70	0·35	0·90	0·80	0·32	0·40

The salts in the milk are chiefly phosphates of lime, magnesia, iron, carbonate of lime, sodium salts, with traces of sulphur and fluoride of calcium.

In the cow the flow of milk becomes very plentiful in about a week after calving, but after a month or so it gradually diminishes in quantity, and after about ten months the animal, as a rule, "runs dry." In the first and second months after calving, when the yield is abundant, it is generally more watery than after the fourth or fifth month.

The milk of an animal is a typical food for the young of its own species, and is all the nourishment required for some time after birth. It induces rapid growth, puppies doubling their initial weight in eight days.

Lambs usually take solid food in a week after birth; foals begin to nibble a little in ten to fifteen days.

It will be noted from the above analyses that milk varies greatly in its composition in the various animals. The milk of the mare contains the largest quantity of water, is rich in milk-sugar, but poor in fats, casein, and albumin. The milk of carnivora is very rich in casein and fat, but very poor or altogether free from sugar. The milk of goats and sheep contains more solids than cow's milk.

Therefore, if the young creature must be artificially fed, it is necessary to feed it with milk or other material which closely resembles its mother's milk in composition. For the foal, cow's milk is used which has been diluted with 10 to 20 per cent. of water, and a little milk-sugar added. If cow's milk is used for puppies, it must have added to it from 5 to 8 per cent. of albumin. In supplying such artificial food, it is imperative to note that it is comparatively free from bacterial infection.

In some instances the mammary secretion may become a source of embarrassment, or even of danger, when it is too abundant or not withdrawn when secreted. This happens more particularly with the bitch, cat, mare, or other animal which is suddenly deprived of its young by death or for special reasons; and the retention of milk is often a cause of discomfort and systemic disturbance with fever, culminating not infrequently in inflammation of the gland. In such cases the milk should be partly withdrawn at gradually increasing intervals until its secretion is diminished or altogether ceases, the diet limited and modified. Mild diuretics and purgatives may be administered to hasten this end. Potassium iodide, belladonna, camphor, alum in large quantities, are recommended to lessen and stop the secretion. To the gland astringent lotions, such as liquor plumbi acetatis, and belladonna ointments, are applied.

CHAPTER V

DYSTOKIA

General Considerations.

Dystokia (δύς, difficult ; τόκος, birth) may be due to too feeble pains, or to an obstacle which the unaided efforts of the animal cannot surmount except after an unusual period of labour, or not at all. The difficulties attending parturition depend upon the resistance opposed to the expelling powers, and this is determined by the relation of the object to be expelled—the presenting part of the fœtus—to the maternal genital passages. Consequently this exaggerated resistance may be due to two causes :

1. *Maternal Dystokia*, due to abnormal conditions of the parturient passages.

2. *Fœtal Dystokia*, due to some unnatural condition of the young animal.

These necessitate particular operations, some of which demand much study, address, and manipulative powers, on the part of the obstetrist.

These difficulties, accidents, and diseases, do not occur with the same gravity nor with the same frequency in all the domesticated animals. They are more commonly noted in animals kept under artificial conditions when closely housed and not obtaining sufficient exercise. Cases of dystokia are much more frequent in the bovine species than in any other. For one case of the kind in the mare or other animal, there are at least ten in the cow. Two Danish veterinarians, Nielsen and Tallich, have estimated that, while they have had 10 cases in the mare, the first had 190 and the second 159 in the cow ; and yet these writers practised in a district where more

horses than cows were reared. In abnormal parturition, however, when it does occur in the mare, there is as a rule more urgency and danger than in the cow, as well as more difficulty in affording relief. This greater danger is due to several causes. The mare is quick and impatient, and the labour is tumultuous; so that if there is dystokia, sometimes the difficulties of correction are increased or become insurmountable, and much damage is done to the genital passage. The violent expulsive efforts of the mare soon paralyze the hands and arms of the operator. Owing to the nature of the placentation in the mare, the duration of the life of the foal, in the case of abnormal labour, does not extend beyond the fourth hour, and when dead the fœtus undergoes rigor mortis; its position is then less easily changed, decomposition soon sets in, and emphysema may increase its size enormously. The neck and limbs of the foal are also very long, and, when abnormally placed, present very great difficulty to the obstetrist in reaching and adjusting with his hand. Injuries and wounds to the genital passage of the mare are exceedingly liable to serious septic infection, and penetrating wounds of the abdomen nearly always lead to a fatal termination. In the cow, on the other hand, the temperament is phlegmatic, and serious injury from labour may not result for hours. The calf usually lives for six or eight hours, and because the cow is not very excitable, and its expulsive efforts are not so vigorous, it is more easily manipulated, and abnormal presentations more readily corrected. In the sheep and goat parturition is often protracted, and assistance is not easily rendered, owing to the introduction of the hand into the uterus not being always possible. Assistance is not often required during parturition in the sow; but when the veterinary surgeon is called in, not only does he find it difficult to insert his hand into the vagina because of the swelling of the mucous membrane, caused by previous manipulation of the owners or attendants, but the presenting fœtus is often dead, and frequently, also, those still lying in the horns of the uterus. Dystokia in the sow under ordinary circumstances means usually a protracted case; and even if the presenting fœtus is successfully removed, the others following it require the attention of the veterinarian. Cases of dystokia are not infrequent

in the bitch, and are commonly due to a large fœtus. It is particularly noted in bitches of small size lined with larger dogs, or in bitches with a large round head and short nose. Here, also, the death of the presenting puppy, if it is left too long, may entail the destruction of the other puppies in the uterus. Cats are also sometimes subjects of difficult parturition.

A very great disadvantage under which the veterinary obstetrist labours in cases of dystokia is the late period at which his services are generally called into request, and often after serious, and even irreparable, injury has been done by unskilful hands—and this in instances in which a little scientific manipulation and some surgical knowledge would have perhaps made all right and safe in a few minutes. Saint-Cyr justly says that the services of a veterinary surgeon can be beneficial only on the absolute condition that he is present in good time. Called upon too late, when the " waters " have escaped for a long period, and the neighbouring empiric has exhausted his science, aggravated a bad presentation, irritated the generative organs by manipulations, tractions, and violent means, then all the ability of the experienced practitioner may be useless. He will find the passage dry, burning, swollen by inflammation, the fœtus more or less advanced into the pelvic cavity, where it is, it may be said, wedged, with the uterus spasmodically contracted on itself, and so closely applied to the body of the fœtus that it is almost impossible to pass the hand between them. How is it possible to manipulate in such a place, how change the vicious position of a fœtus which the greatest efforts cannot make advance or retire? How can a sharp instrument be carried into the uterine cavity, and used with safety, when the hand alone can scarcely be made to enter it?

It is in these circumstances that a practical knowledge of obstetricy is most valuable, and renders him who possesses it a very great acquisition to an agricultural or pastoral district. It is, however, attended with many inconveniences, hardships, and difficulties, and it is, especially in the larger animals, a most arduous and fatiguing occupation. Long and powerful arms and fingers and good physique are of great advantage to the operator, but it is more essential that he should be gifted

with presence of mind, coolness, and fertility of resource, so as to take into consideration all the circumstances of the case, devise his method of procedure, and carry it out promptly.

Proprietors of animals should, in their own interests, suffer no delay to occur in sending for the veterinary surgeon as soon as they perceive that parturition is not progressing regularly; and they should carefully abstain from any violent handling of, or traction on, the fœtus, which might render irremediable a difficulty often easy to surmount at the commencement by anyone sufficiently acquainted with obstetrics.

On his part, the veterinarian should not lose time in giving his services, as every moment's delay may render the case more difficult, and tend to compromise not only the life of the young animal, but also that of the mother, as well as the interests of the owner and his own reputation. It is essential that he should be provided with certain instruments, as obstetrical operations are partly performed by means of these as well as by the unarmed hand, which is, after all, the most perfect instrument, and should always be preferred to instruments where possible. But in some cases instruments are essential, and the practitioner must come provided for all contingencies. The necessary apparatus may be carried in a leather or canvas bag or a small box. The essential portion of the equipment comprises the following:

Two soft, strong cords, about 4 or 5 feet long and $\frac{1}{4}$ to $\frac{3}{8}$ inch thick, with a loop at one end.
Two hooks—one long, the other short.
A crutch or repeller.
An embryotomy knife, some form of bone saw or chisel, and spatula for skinning fœtus.
Apparatus for injecting fluids into the uterus.

Such apparatus is simple, easily cleaned and sterilized.

Drugs to be included should consist of a lubricant—lard, or linseed-meal (for making linseed-tea); antiseptics, such as boric acid, potassium permanganate, lysol, carbolic acid; stimulants—*e.g.*, ammonia compounds, nux vomica, and pituitrin; and sedatives, such as chloral hydrate, chloroform, belladonna.

For the smaller animals, such as the bitch, the equipment should consist of parturition forceps, one or two small blunt hooks like buttonhooks, syringe, lubricant, sedatives, stimulants, and antiseptics, as above noted, as well as a pocket-case of instruments for ordinary surgical operations.

All parturition instruments must be perfectly clean and sterilized before use.

On reaching the patient, all information concerning it should be gathered at once: the period when labour commenced; if the "water-bag" has ruptured, and when; if the animal has gone its full time, or exceeded it; if it is a primipara, or, if not, if its previous parturitions have been favourable. Then, an examination should comprise the general appearance of the animal—whether weak or strong; the character of the pulse; and the nature, frequency, and intensity, of the expulsive efforts, as well as the condition of the mammæ and external genital organs. Before proceeding farther, the veterinary surgeon should insist that the place in which he is to operate should be roomy, clean, and well bedded down, in order that he may work with safety to himself and with a moderate amount of surgical cleanliness.

The coat of the obstetrist must then be removed, and the shirt-sleeves rolled as high as the shoulders; indeed, with the large animals, when there is a likelihood of much manipulation being required within the cavity of the uterus, all the clothing should be removed as far down as the waist, a sleeveless woollen vest put on to protect the operator from cold, and some operating gown over it to prevent his other clothes from being saturated with the discharges of the animal.

The back of the hand and the arm should be well smeared with a lubricant, such as carbolized oil, vaseline, or lysol solution, not only to render their introduction into the genital passages more easy and less irritating to the lining membranes, but also to some extent to protect the operator against infection; this is especially necessary if the fœtus is dead and decomposing. A cutaneous eruption, indeed, often appears on the arms of the operator merely through having manipulated for some time in genital organs, the mucous membrane of which was only irritated and inflamed or simply swollen and bruised. Most frequently the disease is only local, and

is a simple limited redness, which disappears in twenty-four hours; at other times accompanied with intense itchiness; frequently it is a pustular, sometimes confluent, ecthyma, the crusts on which are occasionally not detached for months; in other cases there are furuncles, abscesses on the arm or over the body. In many cases the affection is accompanied by fever, anorexia, great uneasiness, and pains so acute that sleep is impossible; there may also be tumefaction of the axillary glands. The course of the disease is generally irregular, relapses are common, and it is a long time before its effects pass off. Death sometimes occurs, and amputation of a portion of the arm has been occasionally necessary.

If possible, the mare and cow should be examined in a standing position, as this is the best. If, however, the animal is lying down, and from exhaustion or paralysis cannot get up, or will not get up—a common circumstance in the cow—then, of course, the examination must be made in this position.

When standing, it should be approached gently and coaxingly. Rigorous restraint is seldom necessary, even with the mare, for the pains of labour usually render the most vicious animals tractable. The mare sometimes requires a fore-foot held up, occasionally a side-line on a hind-pastern, or hobbles on both hind-pasterns, and perhaps a twitch on the nose. With the cow, a strong man holding the animal's head is sufficient to make it stand quiet. Lateral movements may be prevented by placing the animal against a wall or partition on one side, and a powerful man at the other side, or by placing a man at each side. The hind-quarters of the animal, when recumbent, are better raised by extra bedding, to remove pressure of the abdominal organs on the pelvis. In order to prevent straining, the back and loins should be pinched by an assistant.

In manipulating the smaller animals, such as the bitch and cat, it is best first to muzzle them and so secure them that they will not bite or scratch the operator, and place them on a table for convenience in manipulation. In these animals the exploration is made with the finger of one hand, the other hand being employed in fixing the fœtus by pressure on it through the abdominal wall.

Before examining the genital passage, it is sometimes

necessary to empty the rectum and bladder. While emptying the former viscus, useful information may be gleaned as to the condition of the uterus, as well as of the pelvis.

In all explorations and manipulations, surgical cleanliness should be observed as far as possible.

In the larger animals, the fingers being gathered together in a cone-like form, the hand—which should not be cold—is inserted carefully and steadily into the vagina at a moment when the animal is not straining, and pushed gently forwards by a slight rotatory movement; but the advance of the hand must be momentarily checked if the straining is at all severe. When once through the vulva, more room is found in the vagina, and the hand and forearm can then penetrate with ease as far as the cervix uteri.

The operator has to satisfy himself during this examination whether the vagina is empty, or if it already contains some portions of the fœtus or its membranes, and what these are; if there is any abnormal condition or contraction of the vagina, or any tumours either within or external to that canal, as well as their seat; if there is any deformity in the pelvis from fracture or exostosis. He also notes whether the passage is dry or contains sufficient mucus to facilitate manipulation or delivery.

Farther forwards, the chief points to be ascertained are whether the cervix uteri still projects into the vagina, or if it is completely effaced; whether the uterus has descended on the floor of the abdomen, or is yet in its ordinary position; whether the os is closed or open, and the extent of its dilatation; whether the texture of the cervix is hard or soft, or more or less twisted.

If the os uteri is open, the hand should be passed gently and carefully into the uterus, and the explorer will ascertain then if the water-bag is ruptured, and, if so, the position of the fœtus, if he has not already encountered it. If the water-bag is not already ruptured, it should not be opened until it is found out that this will not take place normally and of its own accord, as usually happens. At this point *the operator must examine the wall of the uterus to make sure that it is not damaged or ruptured by the efforts of the animal or previous manipulation by empirics.* This examination must be carefully

made in order to safeguard the interests of the veterinarian, and the owner must be informed when any damage is discovered. If the membranes are ruptured, the hand must be passed into the uterus in order to discover the situation of the fœtus—the kind of presentation and position, the manner in which the limbs and neck are disposed, and any complications which may be present. Sometimes there is considerable difficulty in assuring oneself as to the exact structures presented, because of the small amount of room allowed for manipulations; but it cannot be too strongly impressed that such an examination should be so complete as to furnish all the requirements of a sound diagnosis on which the indications for affording assistance can be readily based. The operator must recognize by the touch each region of the body presented. The upward or downward direction of the plantar surface of the foot indicates whether the fœtus is in the vertebro-sacral or dorso-sacral position. The fore-limb is distinguished from the hind by the shape of the joints and their method of flexion, if this can be made out, by the shape of the knee and hock, and especially by the prominent tuber calcis. The point of the hock, or tuber calcis, may be mistaken for the point of the elbow, but the relation of the latter to the chest serves to distinguish them. The head is distinguished by the mouth, eyes, and ears; the neck by its shape, and by the mane in the foal; the chest by the ribs and intercostal spaces; the shoulders by the withers and scapula. It is necessary to ascertain, when the limbs are presented, whether they belong to the same fœtus, because in subsequent manipulations the state of affairs would only be made worse if traction were exerted at once upon two fœtuses. In addition, the obstetrist should judge at the same time of the volume of the fœtus and its proportions. This is particularly necessary in the case of monstrosities, and in some instances it is most difficult to decide what the hand may alight upon in such an examination. Kopp alludes to the case of a mare which he examined during parturition, when he found a fœtus affected with hydrocephalus in such a degree that for a long time he thought the head was the thorax.

From this examination the operator can decide as to the measures which are indicated by his diagnosis. He must form

an opinion as to whether both fœtus and mother can be saved. If only one, then, if both are living at the time, he must inform the owner of his opinion before proceeding farther. As a general rule, it is more profitable to save the mother and sacrifice the fœtus. If it is a question of saving the mother's life, he must be able to say whether there is some reasonable hope of this result. The destruction of the patient should only be recommended or urged when there are substantial grounds for believing that the case is hopeless.

The veterinarian then settles upon a definite plan of procedure, and arranges accordingly.

Whatever is necessary to be done should be accomplished without delay, so as to spare the animal pain and exhaustion. When the difficult parturition is due to insufficiency of the expelling forces alone, this may be remedied by therapeutic means and rational traction of the fœtus to assist expulsion; but more frequently, while the expulsive efforts are normal, there is undue resistance. In the latter case we must overcome the resistance according to its character. These methods we will consider in their proper place.

The following table gives a synopsis of the causes of dystokia in the principal domesticated animals (after Saint-Cyr):

- Dystokia
  - Maternal
    - Pelvic constriction.
    - Displacement and altered relations of the uterus.
    - Morbid alterations of the maternal organs.
    - Umbilical cord.
  - Fœtal ...
    - Independent of presentations, by—
      - Excess in volume
      - Excess in growth of hair
      - Diseases
      - Monstrosities
      - Multiparity

      } of the Fœtus.
    - Dependent on the presentations:
      - Anterior
      - Posterior.
      - Dorso-lumbar
      - Sterno-abdominal.

CHAPTER VI

MATERNAL DYSTOKIA

We have already referred, when dealing in general terms with dystokia, to cases where the expelling powers are weak, but the condition otherwise normal, and have sufficiently described their causes, symptoms, and treatment.

DYSTOKIA FROM PELVIC CONSTRICTION.

Dystokia from constriction of the pelvis is sometimes observed in animals. Any alteration in its dimensions or shape, whether general or partial, is a more or less serious

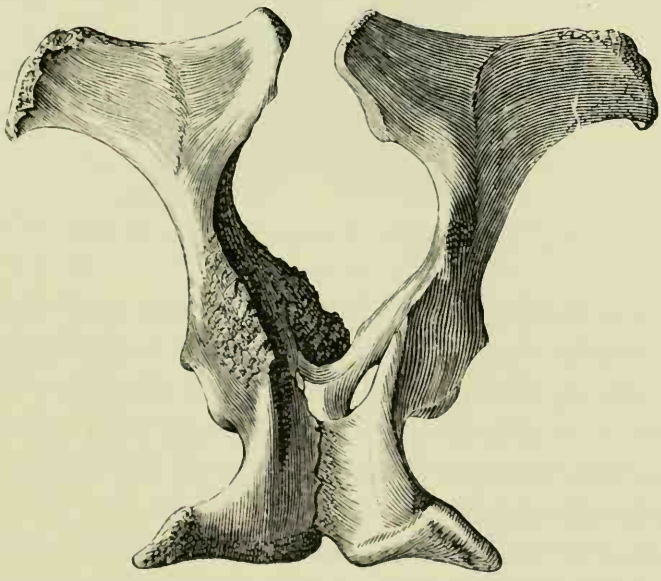

Fig. 66.—Completely Deformed Pelvis: Mare. (Saint-Cyr.)

cause of dystokia. A pelvis generally reduced in all its dimensions is occasionally observed in all the domesticated animals.

Complete Deformity is very rare. When due to rickets it is

more frequently noted in the pig, in which the pelvis may be so small as to prevent the entrance of more than two fingers into the vagina. Two cases of general constriction of the pelvis—one of the mare, another of the female ass—are described by Saint-Cyr. The supero-inferior diameter in the mare was only 6 inches, the bis-iliac $4\frac{1}{4}$ inches.

Another kind of deformity described consists of a depression of the sacrum, which is recognized externally by an abrupt hollow existing towards the posterior third of the croup.

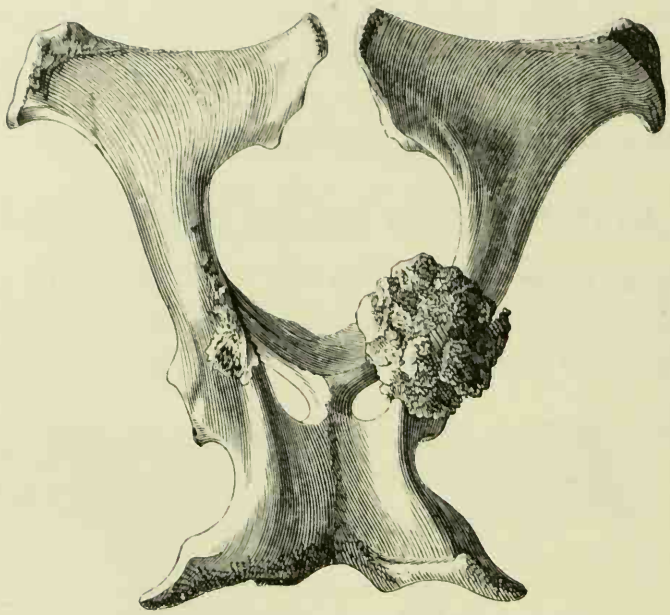

FIG. 67.—PELVIC EXOSTOSIS. (SAINT-CYR.)

The sacrum constitutes a projection at the roof of the pelvis, and diminishes the supero-inferior diameter of the cavity.

Exostoses on the pelvic bones, when they project into the pelvic cavity or encroach on its openings, may become a more or less serious obstacle to the passage of the fœtus. They are not rare in old mares.

Fractures of the innominate bones or sacrum, each united by a hard, large callus, may prove an obstacle to birth if the callus projects into the cavity. Those fractures most frequently acting in this way appear on the shaft of the ilium, through the cotyloid cavity and through the pubis and ischium. In some cases there is, in addition to the callus, a deformity of the pelvis caused by displacement of the

fractured pieces. Female animals which have sustained an injury of this kind should not be employed for breeding purposes if the deformity is great.

Tumours of Various Kinds—such as fibromata, melanotic and cancerous tumours—may prove a cause of dystokia. Melanomata at the root of the tail, in the connective tissue of the pelvis, is most common in grey horses.

Treatment.—Should the veterinarian be consulted about a patient during pregnancy, and find a constriction of the pelvis

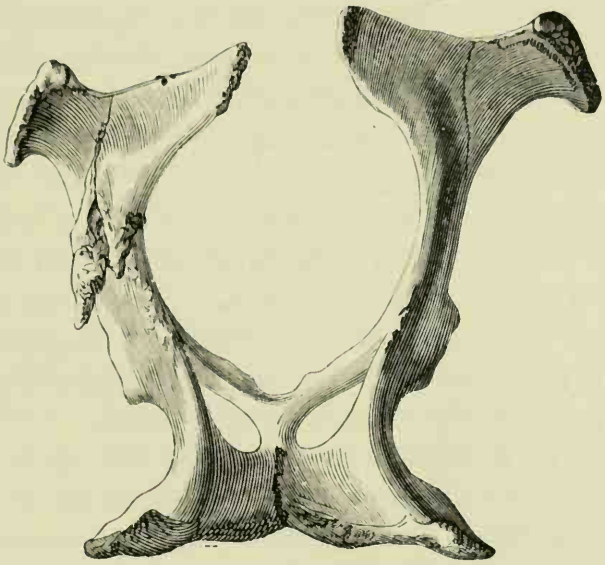

FIG. 68.—FRACTURE OF THE PELVIS. (SAINT-CYR.)

which would render parturition dangerous or impossible, the best course to adopt is to recommend artificial abortion. The fœtus may at this time easily pass through the pelvis.

Artificial Abortion may be produced in several ways, and is generally more successful with the mare than the cow, because of the greater excitability of the cervix uteri, and the readiness with which it can be dilated in that animal. Drugs such as ergot and savin are very uncertain ecbolics in the domesticated animals, and their administration is accompanied by serious danger to the mother. Three chief methods of procedure in producing abortion have been employed with success in these animals.

1. *Digital Irritation of the Cervix Uteri and Dilatation of the Os.*—This is accomplished in the following manner: The hand is introduced into the vagina, and first one finger, then

two, are insinuated into the os by a semi-rotatory movement; and finally the whole hand is inserted as the part dilates. If the operation is repeated several times, labour pains will soon ensue. As the manual exertion is rather fatiguing, elastic bags, or other dilators of the os uteri, may be employed. A better and more successful method is the introduction of a long elastic catheter between the fœtal membranes and the uterus. Dilatation may be effected by passing the hand through the os and separating the placenta from the uterus with the fingers. In ordinary cases the expulsion of the fœtus in mares occurs in from six to twelve hours. This is a very difficult task in cattle on account of the very narrow cervical canal and its thick rigid walls, and is not to be recommended for the smaller animals.

2. *Puncture of the Fœtal Envelopes.*—The os uteri is again dilated, and the envelopes punctured either with the finger or a long, more or less pointed sound. The liquor amnii soon escapes, and uterine contractions begin. Expulsion of the fœtus follows in from twelve to forty-eight hours. This method is particularly efficacious with cattle.

3. *Vaginal Irrigations.*—Irrigation of the vagina with cold water (or water at a temperature of about 90° F.), made by means of a syringe or injection-tube, and continued for a quarter of an hour every three hours, will induce labour pains at about the fourth injection, and effect the expulsion of the fœtus towards the second, third, or fourth day. This method is more particularly adapted for smaller animals, though it will also succeed with the larger. The only danger to be apprehended from it is an attack of metroperitonitis.

4. In cows and heifers the most certain method of inducing abortion consists in the enucleation of the corpus luteum as described in the section on "Sterility."

If parturition has already commenced when the veterinarian is called in, then he must consider the various methods of removing the fœtus.

(*a*) *Forcible Extraction of the Fœtus* through the narrowed passage. The veterinarian must first ascertain the nature, seat, and degree, of the constriction by a vaginal examination In the mare and cow, if the closed fist cannot move freely in the pelvis, then forcible extraction should not be attempted,

because the diameter of the closed fist is about three times less than that of the chest of the fœtus. If the constriction is due to a tumour, then it may be capable of removal or of displacement to permit of sufficient dilatation of the canal.

If the extraction of the entire fœtus is discovered to be practicable, and the position is favourable, then judicious traction should be employed. It will be much facilitated, should the fœtus and passages be dry and tenacious, by their lubrication with lard, oil, linseed-tea, or a 1 per cent. solution of lysol. Should the fœtus become wedged in the passage and cannot be pulled through, then it should be pushed back, and the passage lubricated to assist movement, before another attempt is made.

When the opinion is formed that the entire fœtus cannot be removed by traction, then the other methods of procedure should be employed without waste of valuable time or energy.

(*b*) *Embryotomy.*—When a careful examination has proved delivery of the living or entire fœtus to be impossible, then the fœtus should be sacrificed to save the life of the mother. Embryotomy is very successfully practised in the cow and mare. In an anterior presentation, removal of one or both of the fore-limbs at the scapula of the fœtus will often allow the remaining portions to be removed by traction. With a posterior presentation, excision of one hind-limb is frequently sufficient to permit the body of the fœtus to be drawn through the passage.

(*c*) *Hysterotomy or Hysterectomy.*—In the mare and cow hysterotomy may be practised when the other methods of procedure are not likely to be successful in order to save a living fœtus. It is particularly advisable in the sow, bitch, and cat, when the pelvic constriction precludes extraction of the entire fœtus, and where vaginal manipulations are exceedingly difficult. To be successful, the operation should be practised before the female is much exhausted by inefficacious manipulations and impotent labour.

DYSTOKIA FROM DISPLACEMENT OR CHANGED RELATIONS OF THE UTERUS.

Delivery may be rendered difficult by displacement or altered relations of the organ containing the fœtus, the uterus, either from hernia of that organ through a natural or accidental opening in the abdominal parietes; from deviations in its direction, whereby the os is no longer in the axis of the pelvis; or torsion of the organ, due to its having made a revolution or become twisted on its own axis.

Hernia of the Uterus—Hysterocele.

Every kind of ventral hernia may be viewed more or less as tending to dystokia, from the important share the abdominal muscles assume in the act of parturition; and when there is a tendency to hernia of any of the organs in this cavity, or when a hernia really exists, this is likely to be increased during labour, and may complicate delivery. But the case is generally all the more serious if the displaced organ is the gravid uterus itself.

Hernia of the uterus is certainly not a very common accident; nevertheless, it is far from being rare, and has been recorded in the mare, cow, sheep, sow, goat, and bitch, and has often proved a very serious obstacle to parturition.

Origin and Symptoms in Uniparous Animals. — The symptoms and other features of this accident rather differ in uniparous and multiparous animals. In such uniparous creatures as the mare and cow, hernia of the uterus is generally not observed until pregnancy is pretty well advanced —towards the eighth or ninth month, or even later in the mare, and the seventh or eighth month in the cow This delay is evidently due to the circumstance that, in the non-pregnant animal, the uterus is small and closely fixed by its ligaments to the sublumbar region; so that if there is a breach in the abdominal walls, it is either the intestine or omentum which passes through it. When, however, pregnancy is advanced, the great size of the organ, together with its weight, brings it in contact with the parietes of the peritoneal cavity; and if there happens to be a weak part or a rupture,

no matter how slight, the heavy uterus gradually forces itself through, and may in time escape altogether from the abdomen along with other viscera.

It would seem that laceration of the abdominal walls may occur in other ways than through external traumatic influences or any appreciable occasional cause, and that in some animals there is a kind of predisposing relaxation or weakening of the abdominal muscles, which leads to their being unable to

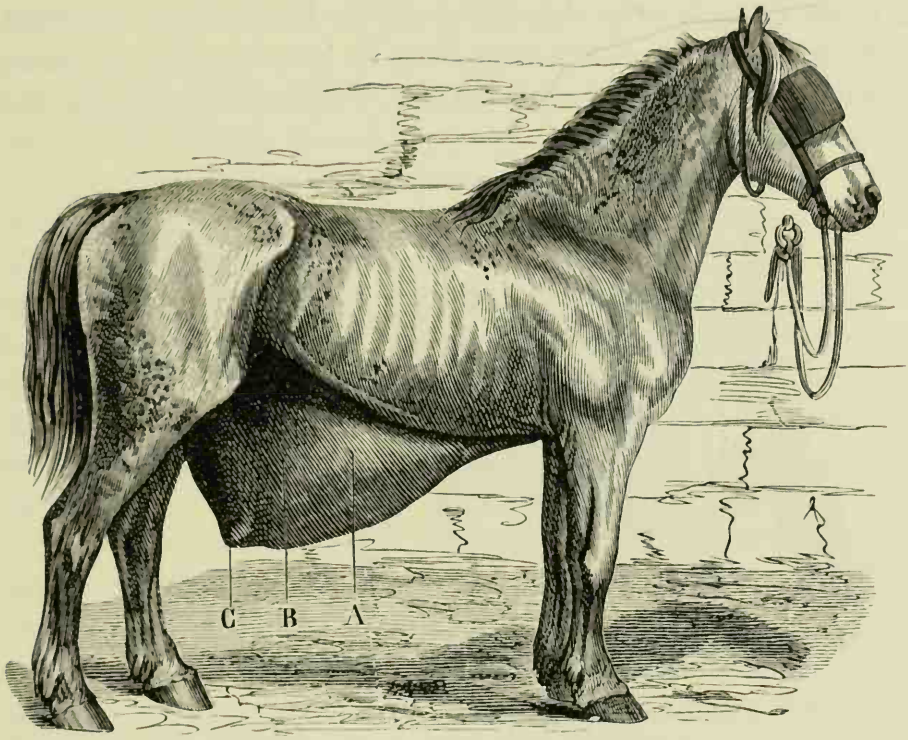

FIG. 69.—UTERINE HERNIA: MARE. (SAINT-CYR.)

A, B, Hernial tumour; C, teat carried down by the tumour.

support the gradually increasing strain thrown upon them by the heavy uterus and its oftentimes very lively and energetic inmate. The muscles are stretched and attenuated, their fibres are separated and some of them rupture, and in this way is formed a rent which gradually enlarges from the increasing pressure. Then a tumour appears externally and towards the lower part of the abdomen, though always a little to one side—usually the left in the mare, the right in the cow—and not infrequently in front of the pubis, in the mammary region.

This tumour, when first noticed, is about the size of a child's head, and not clearly defined; but it rapidly enlarges, and in a few days may acquire prodigious dimensions—descending as low as the hocks, or even nearly to the ground, pushing the mammæ to one side or carrying them with it, extending as high as the vulva and almost as far forwards as the sternum, giving to the abdomen a singular appearance.

These extraordinary herniæ are most frequently witnessed in cows, though several veterinarians—Lecoq, Binz, Leconte, Lafosse, Williams—have seen them in mares. In very many instances they are due to violent efforts, kicks, blows, and other external injuries.

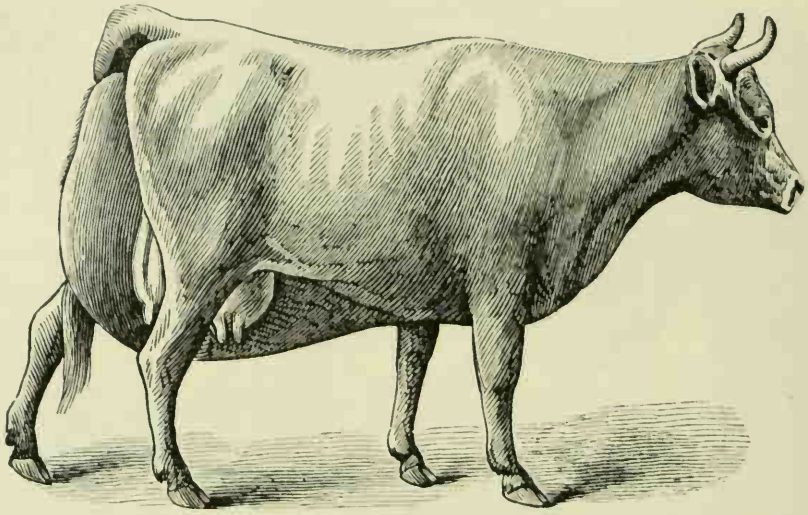

FIG. 70.—UTERINE HERNIA: COW. (ZUNDEL.)

When the hernia is recent, and especially if it occurs in the mammary region, it is generally surrounded by a considerable œdematous swelling. This swelling disappears after parturition, though the hernial tumour does not diminish in volume, the digestive organs having occupied the space previously held by the fœtus. Then, owing to this emptying of the abdominal cavity, the belly is wonderfully retracted, and the flanks are so drawn together that the fingers may be made almost to touch through them on each side.

Before parturition, by palpation, the various parts of the fœtus may be distinguished, while its movements are perceptible by the eye or hand. This uterine hernia does not

cause any loss of condition, but interferes with the movements of the animal.

Origin and Symptoms in Multiparous Animals. — In multiparous animals uterine hernia takes place during the non-pregnant condition. The length and mobility of the cornua and their contact with the abdominal walls allow them to pass through openings in these walls. There is formed, at first, a small tumour the size of a pigeon's or hen's egg; this tumour is soft and easily reduced, and may attract little or no attention while the animal is unimpregnated. After impregnation, however, it daily acquires larger dimensions; one or more ova have descended into the hernied portion, localized themselves there, and become developed into fœtuses, without the bitch or sow showing much, if any, disturbance. The usual seat of the hernia is in the mammary region, to the right or left of the linea alba, occasionally extending back to the vulva. The resulting swelling is soft and painless, and the skin covering it is not discoloured. Rarely a uterine hernia has been found in the mesentery. When the fœtuses are well developed, their form may be distinguished by palpation. It is sometimes mistaken for a mammary tumour, but this hernia can frequently be reduced by taxis or manipulation, and a hernial ring can be made out in those herniæ which are irreducible.

Pathological Anatomy. — In ventral herniæ in the larger animals, the seat of the rupture lies behind the umbilicus, in front of the pubis and at one side of the linea alba. The opening in the abdominal wall is brought about by a separation and rupture of some of the fibres of the transverse, rectus, and oblique muscles. Sometimes the rupture is as clean and sharp as if it had been made with a knife. The opening is more or less circular, oval, or triangular, and varies in size, may be as much as 20 inches in diameter, its largest diameter corresponding to the axis of the animal's body. In the later stages the linea alba may be involved. In a few cases the abdominal tunic withstands the strain, but most frequently gives way. Sometimes, also, the peritoneum may escape rupture, and, being extended, forms with the skin the covering of the hernial sac. In many cases it gives way, and the hernial contents are only covered by skin.

In a recent hernia, hæmorrhages take place into the lips of the rupture; but in a later stage the borders of the hernial ring are uniformly red, and by cicatrization become rounded, thickened, dense, and resisting. The connective tissue beneath the skin is condensed in a kind of smooth membrane continuous with the margins of the rent, and forms a second tunic to the hernia. Before parturition the hernia is occupied almost exclusively by the gravid uterus, which is wholly or in part lodged in this accidental diverticulum. After delivery, however, the uterus often, though not always, ascends into the abdominal cavity; but whether it does so or not, other viscera—such as the rumen with the cow, and the colon and small intestines with the mare—find their way into the pouch.

Treatment.—In the larger animals, in the cow and mare, if abortion is not artificially induced, then a strong bandage of canvas, well padded and buckled over the loins, should be applied to the abdomen to remove the tension from the hernial sac, and the patient carefully watched before parturition, so that assistance may be offered when necessary. Sometimes animals suffering from uterine hernia bring forth their young spontaneously without any bad results to themselves or their progeny, as recorded by Leconte and others. But as a rule parturition is always more protracted and difficult, and assistance is needed to effect delivery; in some instances delivery is impossible, and mother and offspring are lost. At parturition, if any difficulty arises, the vagina must be explored. Should the os be contracted, it must be dilated by hand. If the presentation is favourable, ropes should be attached to the presenting parts, and traction applied to assist in delivery. Sometimes delivery is made more favourable by placing the animal on its side or back, the uterus and its contents then passing into the abdomen if the hernia is reducible. The nature of the aid required will depend on the presentation and situation. If the hernial sac threatens to give way, it is necessary to perform Cæsarian section as early as possible in order to remove the fœtus living. The chances of recovery of the mother are very slight, as it is impossible in most cases to reduce the hernia and close the opening, the bowels soon emerging through the wound immediately the fœtus is removed. With the cow it is very often more economic to call in the services of the butcher.

It is generally injudicious to attempt to breed from an animal affected with hysterocele or abdominal hernia of any description, notwithstanding the fact that this condition may not militate against gestation and parturition in every case.

With the smaller animals, and especially the bitch, the best treatment is to operate. The operation may be carried out during gestation, or at the time of parturition, but before the bitch is exhausted. Under anæsthesia, and with all surgical precautions, the skin is incised over the hernial sac, and the latter enucleated by blunt dissection from the surrounding tissues up to the hernial ring. The sac is then opened. If in the early stages of gestation, the uterus may be returned to the abdomen. When one horn is involved, and the hernia is irreducible, then that horn and the corresponding ovary may be removed. In the later stages of pregnancy or at parturition one of two courses may be adopted: (1) The uterus may be opened, and the fœtuses removed through the one incision. The uterine wound is sutured, and returned to the abdomen. (2) The whole uterus, with its contents and the ovaries, may be excised, and the stump of the uterus, after being ligatured, is returned to the abdomen. This latter method is the safer when the uterus has been opened at parturition. The hernial sac is ligatured as close to the abdominal wall as possible, and the hernial ring closed with interrupted sutures. Last of all, the skin wound is closed in the same way. The rest of the treatment is as for laparo-hysterotomy.

Deviation of the Uterus.

By the term *deviation*, when applied to the uterus, is meant a change in the direction of the organ, by which the cervix no longer corresponds to the axis of the vagina. Only one kind has been noted in the domesticated animals, inferior obliquity, and is extremely rare. It has only been observed in the cow. In this animal, because the abdominal muscles are inserted by a thick tendon into the inferior aspect of the pubis, the floor of the abdomen is on a lower plane than that of the pelvis; so that there is a kind of step between the cavities, the height of which varies in different individuals, but

has been found to be as much as 3, 4, or 5 inches. Occasionally, then, the body of the gravid uterus, instead of being directed forwards, inclines directly downwards, and lies against this pelvic step, not passing beyond the umbilicus. The cervix of the uterus is therefore directed upwards in the direction of the sacro-vertebral angle, and may even compress the rectum against that part. On that account the os no longer corresponds to the axis of the vagina, and this great deviation in the uterus entails a similar change in the attitude of the fœtus, the head of which is directed towards the sacrum, while the buttocks rest on the pubic step. During parturition the uterine contractions are no longer directed towards the cervix; the os dilates slowly, or not at all, and in order to render parturition possible assistance must be given. Garreau has observed that labour may be suspended altogether; the fœtus dies, becomes mummified, and is retained for perhaps a very long time.

Diagnosis.—The long duration of labour and the inutility of expulsive efforts prove that some obstacle to delivery must be present. Consequently, vaginal exploration is resorted to, and when the hand is passed into that canal it reaches a kind of imperforate cul-de-sac, at the bottom of which is a large round tumour, into which no opening can be found. This tumour is the lower face of the uterus, which, pressed against the corresponding wall of the vagina, projects into the pelvic inlet. By raising the hand towards the sacrum, the os will be discovered much removed from its normal position, and situated just above and in front of the uterine tumour.

When the os is more or less dilated, there is frequently formed at this point a kind of membranous transverse fold, raised in the form of a valve analogous to the partition separating the sacculations of the large intestine of the horse. This band is stretched across the lower part of the os, and has to be surmounted before the hand can touch the fœtus. The more or less vertical position of the fœtus will also act as a guide. In a case described by Garreau the os was indurated, and the fœtus remained three months beyond the normal time, after which it was removed by Cæsarian section and the cow did well. Schaack describes rupture of the uterus and fatal hæmorrhage as a complication resulting from strong traction upon a fœtus in this position.

Treatment.—In slight cases the deviation may be reduced by raising the abdomen with a folded sheet or blanket or a plank held by an assistant on each side of the cow.

In severe cases the animal must be cast gently on a thick bed of straw and placed on its back, and kept in that position by bundles of straw. The weight of the fœtus carries the uterus down towards the spine; the body of the organ is depressed and the cervix raised towards the pubis (now superior); the obliquity of the uterus is thus got rid of. Parturition has thus been found by Schaack and Peuch to be rendered easy.

Torsion of the Uterus: Contorsio Uteri.

Torsion or "twisting" of the gravid uterus on its long axis—which often involves not only the cervix of the organ, but also the vagina—is most frequently observed in the cow, is not uncommon in the ewe and goat, but is rare in the mare and the small multiparous animals. In the sow and bitch, tne uterine cornua, but not the body, become displaced and twisted, and even become hernied by the broad ligaments.

History.—The existence of torsion of the uterus was first indicated by Boutrolle in the "Parfait Bouvier" (second edition, 1766), but it was only during the nineteenth century that general attention was drawn to the exceedingly great importance of the condition. It was described by Lecoq of Bayeux, in 1837, in a "Mémoire sur le Part Laborieux." Complete rotation of the uterus was first noted among Continental observers by Richner, a Professor at the Berne Veterinary School, who, in his "Systematic Treatise on the Diseases of the Bovine Species" (published in 1840), advises rolling the body of the cow as a means of remedying the accident. Shortly afterwards Blickenstorfer of Zurich wrote a memoir on the subject; and it was also well described by Mazure and Pouchy.

In Germany, about the same time, it was the subject of investigation and treatment by Schmidt of Bavaria, Vix of Giessin, Fricke of Hanover, and Irminger. Fricke cured a case by fastening the feet together, two by two, and rolling the animal in a contrary direction to that in which the uterus

was twisted. In Britain, in 1840, Mr. Carlisle of Wigton, under the head of "Cæsarian Operation," described an undoubted case of torsion. After this period, memoirs on it have been published by Dénoç, Bordonnat, Rossignol, Gaven, Bouley, Goubaux, Chauveau, Liautard, Marlot, Coquet, and many others; while it is alluded to with more or less detail in the treatises of Rainard, Baumeister and Rueff, Zürn, Harms, Lanzillotti-Buonsanti, Cruzel, Saint-Cyr, etc.

Nature and Frequency.—This accident consists in a rotation

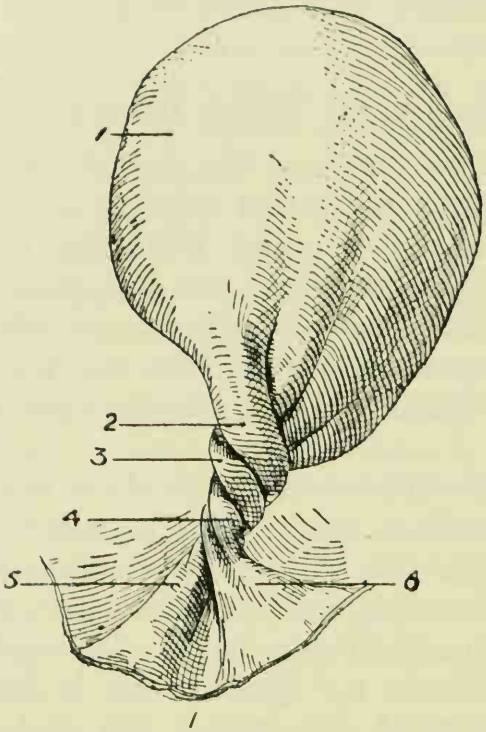

FIG. 71.—INCOMPLETE TORSION OF THE UTERUS.

1, Body of the uterus; 2, 3, 4, spiral twists directed from left to right; 5, cervix uteri and vagina; 6, suspensory ligament; 7, pelvis.

of the uterus on its axis, by which its upper surface may successively become lateral and inferior; and lateral on the opposite side and superior, when the revolution is complete. This torsion may take place in two opposite directions; the upper surface may be left lateral or right lateral, constituting left and right torsion respectively. Torsion may be incomplete or complete. The incomplete torsion may be quarter, half, or three-quarters, according to the degree of rotation. When the organ makes two complete turns we have double torsion.

The result of this rotation is that the vagina and the cervix uteri, because of their attachments, cannot follow the uterus, and therefore become twisted in a cord-like fashion, whence arises stricture of the os—the constriction being all the greater as torsion is complete—and utter impossibility to effect delivery of the fœtus unless the uterus is replaced in its normal position, or its contents are removed otherwise than through the os.

Incomplete torsion is by far the most frequent form encountered in practice. It is often so slight that it might be compared with deviation of the uterus, there being only a trifling displacement of the cornu containing the fœtus, which carries the body of the uterus with it.

In other instances the torsion consists of a quarter or half turn, the upper face of the uterus having become lateral or inferior; sometimes the gravid cornu occupies the inferior region of the abdomen; and at other times, making a wider rotation, it is lodged in the opposite flank. In examination of an affected animal it is only possible to give an approximate estimate of the degree of torsion. One, two, three or more parallel ridges appear in a twist according to its degree, whether quarter, half, three-quarters, or complete, as one would expect with a somewhat long and supple cylinder such as the vagina or cervix uteri. These ridges may sometimes be mistaken for separate twists. Double or multiple twists, although they have been seen, are very rare.

The relative frequency of this accident in the cow is explained anatomically in two ways:

In the cow the concave curvatures of the uterine cornua look downwards. To these curvatures the broad ligaments are attached; so that, if the uterus be considered as freely suspended in the abdomen, each cornu is turned outwards and upwards, while its base, near the body of the organ, although drawn in the same direction by the ligaments, yet retains its position, being firmly maintained in it by the body of the uterus, which also receives the insertion of the broad ligaments on its lower face. This insertion causes the uterus to project above the ligaments, which are very broad, particularly at their anterior border, and widely separated from one another near their lumbar attachment. The ligaments

suspend the uterus loosely in the abdomen, and allow it to become fully developed during pregnancy. At this period, too, they become greatly increased in substance and length. As gestation advances, nearly the whole of the great size of the uterus is due to the development of the one horn in which the fœtus is situated; and as the other horn retains its normal size, the twisting of this around its ligament, and consequent torsion of the cervix, can be readily under-

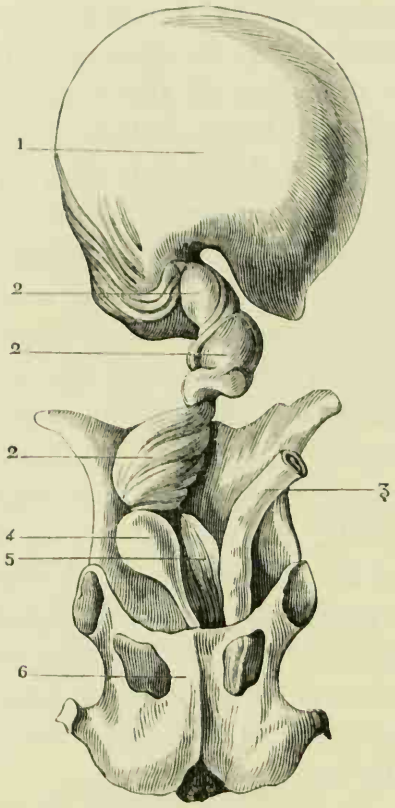

FIG. 72.—MULTIPLE TORSION OF THE UTERUS. (GURLT.)

1, Body of the uterus; 2, 2, 2, torsion, involving the body of the organ; 3, rectum; 4, bladder; 5, vagina; 6, symphysis pubis.

stood. Such is the explanation of the accident given by Chauveau.

According to Goubaux, it is in consequence of the development of the cornua during gestation, and their projecting greatly beyond their means of attachment or suspension, the broad ligaments being thrown altogether back. During pregnancy the cornua are considerably lengthened, while the ligaments do not increase in breadth, their points of

attachment to the inner face of the flank or the ilium remaining invariably the same. This projection of the gravid cornu beyond the broad ligaments supporting it—and which may be as much as nearly 2 feet—must render the production of torsion remarkably easy.

Probably a combination of these two explanations would indicate best the reasons for the tendency to torsion of the uterus in the cow. The relative infrequency of this occurrence in the other domesticated animals is undoubtedly owing to the different arrangement of the uterus and its suspensory ligaments.

Occasionally the torsion is confined to the gravid uterus or to the body in front of the cervix, but most frequently it involves the vagina as well as the cervix and body of the organ. Sometimes it causes rupture of the broad ligaments, and instances are recorded by Dense and Albrecht in which the rupture has extended to the uterus. Occasionally the fœtus escapes through the rupture in the uterus and develops in the peritoneal sac, constituting an extra-uterine pregnancy.

The relative frequency of the disease varies with the district, and is related in some way to the nature of the country and the method of rearing cattle. Leconte has observed it in twelve cases out of three or four hundred cases of difficult parturition ; Lemaire has met it seven times in four years.

Etiology.—The causes attributed to this condition are very diverse. Those which appear to operate most frequently are slips or falls, and particularly on the hind-quarters—croup or hocks. Uterine torsion is thus often witnessed among cows at liberty in pastoral countries where the ground is broken, intersected, or hilly, whilst it is almost unknown in the plains. Slipping upon its hind-quarters, horn thrust in the flank by a companion cow, rolling, casting, falling when jumping a ditch, slipping up when descending a steep hill, meteorism, severe toil, deformity and malposition of the fœtus, spontaneous and energetic movements of the fœtus *in utero*, in order to get rid of uncomfortable sensations and avoid unpleasant positions, violent and irregular movements of the animals during the early stages of gestation—these have all been put down as causing torsion of the uterus. This disease is often met with in primiparæ.

Symptoms.—This accident ordinarily takes place towards the termination of pregnancy—from the eighth to the ninth month in the cow. As a rule no particular indication of inconvenience or suffering is noted from this cause until parturition. Even then, in the initial stages, there is no sign which can be relied upon to prove the existence of torsion.

In some instances tumefaction of the vulva is not well marked, and it remains dry and appears to be buried more deeply between the ischial tuberosities. Occasionally some difficulty in micturition is observed before parturition, the urine escaping only in small quantity at a time, or there may be total suppression. This is due to the compression of the bladder by one of the twists in the uterus.

The first labour pains, which soon appear, are usually feeble, and are separated by a comparatively long interval of quiet, during which the animal appears to have nothing amiss. Nevertheless, as time goes on, symptoms are evinced now and again; and though the labour pains succeed each other more rapidly, and become more energetic, yet birth does not seem to advance; the "water-bag" does not show itself, and nothing appears externally. This condition may persist for six, twelve, twenty-four, and even forty-eight, hours before assistance is given.

In other instances the symptoms are more marked and severe during this first period. The animal appears to suffer from the pain of intense uterine and abdominal spasms, marked by violent straining, which comes on at longer or shorter intervals, and by great restlessness. In many instances, after a period varying from twelve to forty-eight hours, these symptoms may disappear, and the animal seems to have recovered. In the course of from one to six days, however, there is a recurrence of the labour pains, and in so urgent a form that there can no longer be any doubt as to real attempts at delivery, although no progress in that direction is shown. As some obstacle to the expulsion now evidently intervenes, the veterinarian, when called in, must make a manual examination.

The oiled hand, on being introduced into the vagina, meets at first with no obstacle; but on advancing into it, the fingers soon encounter one or more folds or rugæ, which render the

passage more and more constricted towards the cervix uteri. Towards the termination of the vagina, the fingers reach a kind of cul-de-sac, formed by the mucous folds, which at this part converge in a spiral manner either to the right or left. Although at first there appears to be no passage, yet it will be found that, by turning the hand in the same spiral fashion as the rugæ incline, the finger will be able to penetrate to a certain depth; and if one of the most prominent ridges be followed in this way, it will be discovered that it has a cork-screw-like course. This is pathognomonic of torsion of the uterus.

The kind of spiral infundibulum in which the hand penetrates varies in dimensions according to the amount of torsion. In the quarter-turn, the hand may be passed, though with difficulty, as far as the neck of the uterus, which may be more or less dilated, and allow the position of the fœtus to be ascertained. The fingers can feel a large, salient spiral ring, which becomes wider as the hand enters deeper into the organ, and which terminates in the cavity of the latter in a wide membranous, fan-like fashion. If the torsion is to the left, this ring inclines to the right, and the membranous expansion in the uterus is directed obliquely from right to left towards the fundus of the organ. The spiral twist is in the direction of the torsion, and the uterus is carried towards the left flank. In torsion to the right, the arrangement is the reverse of this.

In the half-turn, occlusion is so marked that the fingers can scarcely be made to enter the obstacle, and the cervix cannot be reached unless the torsion is beyond it. There are always two prominent rings—two mucous folds which cross each other, but which, as they recede from the torsion, become wider apart and spread like a fan.

In the complete turn, the occlusion is such that only one finger can penetrate to a very slight depth in the spiral stricture, and the direction of the rugæ is very baffling, as they seem to intersect each other and to run in opposite directions.

In half and complete degrees of torsion the fœtal membranes are generally intact; in the quarter degree the membranes are sometimes ruptured, and the waters discharged for a

considerable period before the animal is examined by the veterinarian.

The fœtus quickly perishes after the first labour pains, and for certain within forty-eight fours. The exact period of its decease greatly depends on the intensity of the pains, and is due to the strangulation of the bloodvessels of the uterus which are involved in the twist. The position of the fœtus varies according to circumstances. It is most frequently in the dorso- or lumbo-ilial, rarely in the lumbo-sacral, as it follows the movements of the uterus; so that in reducing the torsion the fœtus should be brought into its normal position. Sometimes, when the twist is slight and the passage sufficiently large, the fœtus partly enters the pelvis, where it may not only be felt, but seized by the parts first presenting. At other times it is entirely lodged in the abdomen; and at others, again, it may be felt towards the pubis in a kind of pouch formed by a duplicature of the uterus beneath the inner opening of the os. Here it sometimes considerably elevates the bladder and meatus urinarius.

The form of the abdomen is sometimes characteristic. The fœtus can generally be found higher in it than normal, towards the flank, on the right or left side. A rectal examination may sometimes be useful, especially when the torsion is complete, in distinguishing the twist, the change in position of the uterus, the tension of the broad ligaments. Occasionally the rectum itself is displaced and drawn towards the entangled uterus.

If the animal is not relieved, the symptoms above indicated persist with variable intensity. The straining and attempts at spontaneous delivery continue either feebly, and with long intervals between, or they are violent and almost incessant. The animal soon ceases to eat and ruminate; it becomes dull and dispirited; fever sets in, and the pulse and respirations are hurried; rigors and grinding of the teeth are remarked from time to time; the lacteal secretion, which had commenced, is suspended; the mammæ become soft and small; the eyes sink in their orbits; and extreme prostration ensues. The creature, unable to get up, constantly lies; the pulse becomes imperceptible; death generally occurs from the third to the tenth day after the earliest symptoms were exhibited.

Exceptionally the fœtus becomes mummified and the cow makes a perfect recovery, and may be fattened.

The *Diagnosis* is made from the symptoms and a vaginal exploration.

Prognosis.—With the cow, torsion of the uterus must be looked upon as a serious accident; for except in a few cases, when assistance is not rendered, the fœtus and mother always perish. By judicious intervention, mother and offspring may often be saved. A cautious opinion must, however, always be given; but its favourableness will, of course, depend upon the brief duration of the parturient symptoms, previous manipulations, the condition of the animal, and also the degree of torsion.

Pathological Anatomy.—At a post-mortem examination of a cow which has lived for many hours after the first signs of parturition, a peritonitis or metroperitonitis is noted. A quantity of blood-stained sero-fibrinous exudate is found in the peritoneal cavity, and a layer of yellow fibrin frequently covers the uterus, and may even cause it to adhere to neighbouring organs. The uterus is highly congested and reddened. The torsion appears as a large, hard cord, composed apparently of a number of spiral strands of unequal size, the closest twined of which are in the middle of the strangulations, and formed by the anterior portion of the vagina and the cervix and body of the uterus. The broad ligaments are sometimes compressed between the spiral folds, which they concur to form; sometimes they merely envelop and obscure these folds. Rarely are these ligaments ruptured. Most commonly they are tense and greatly stretched, tightly compressing the cervix and rendering occlusion of the os all the more rigid. If the uterus be turned in a direction opposite to that of the twist, the strands of the latter gradually open, widen, and are effaced, the strangulation disappears, and the genital passage regains its normal shape.

Exceptionally gangrene of the uterus is present, probably due to obstruction of the bloodvessels implicated in the torsion.

As a complication, a more or less extensive rupture, com plete or incomplete, of the uterus may exist—probably due to severe uterine contractions. This rupture is most frequently

met with in the body, in the vicinity of the twisted portion, or at the junction of the gravid cornu with the uterus. The fœtus has been at times found partly fixed in the fissure.

The condition of the fœtus varies with the time that has elapsed since its death. Sometimes it is in a state of perfect preservation, while at others it is in an advanced state of putrefaction, the hair and hoofs coming off readily, and the body swollen, emphysematous, and emitting a disgusting smell. In rare cases the fœtus is mummified, even when fully developed.

Treatment. — The sole indication for the relief of this accident is to untwist the uterus. This, however, is not always possible. Various methods are recommended to accomplish this object.

1. *Rotation of the Cow's Body* is a very simple method which ought first to be tried before any other form of treatment. This method consists in rolling the animal affected with uterine torsion in such a manner that the twist is effaced and the genital passages are open for the passage of the fœtus.

The first step, after ascertaining the existence and direction of the displacement, is to empty the udder of its milk, so as to prevent the gland being injured during the operation. For the operation, a field, or a roomy place covered with a thick layer of soft litter, such as straw or moss, should be chosen. The cow should then be thrown, and all the limbs tied together at once, or first the two fore and then the two hind limbs, these being fastened together afterwards and not allowed to cross.

For an ordinary-sized cow five assistants are necessary; one of these is to be placed at the animal's head to hold it and make it follow the movements of the body; the second should keep the limbs as close to the belly as possible when the cow is rolled over on them. The hocks should be kept flexed, in order to prevent the udder being damaged and to avoid muscular injuries to the upper part of the hind-limbs. The other three assistants should lift and roll the cow and aid the second in pulling at the hind-limbs when the animal is being placed on its back. If the torsion is to the left, the animal should be cast on its left side and turned successively

on its back, right side, sternum, and left side; if to the right, the rolling should be in the opposite direction. The indication of the side to which the torsion is directed is given by the direction of the hand in vaginal exploration (see Figs. 73 and 74). During the rolling, the hand and arm are kept inserted into the vagina as far as possible, in order to try and fix the uterus. Should the os be accessible and dilated, some part of the fœtus must be secured, preferably a limb; and this must be maintained in one position. If the fœtus cannot be reached, then nothing remains but to make the wall of the vagina the point of resistance until a better can be made

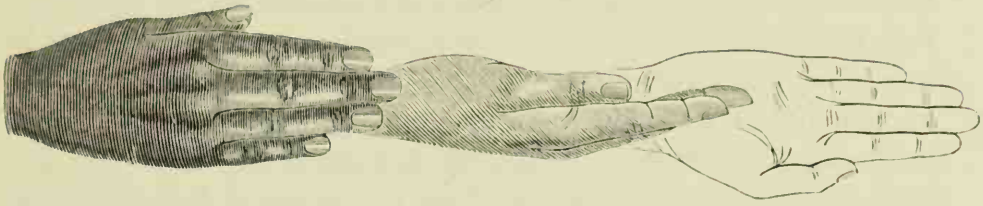

FIG. 73.—RIGHT UTERINE TORSION: MANIPULATION. (SAINT-CYR.)

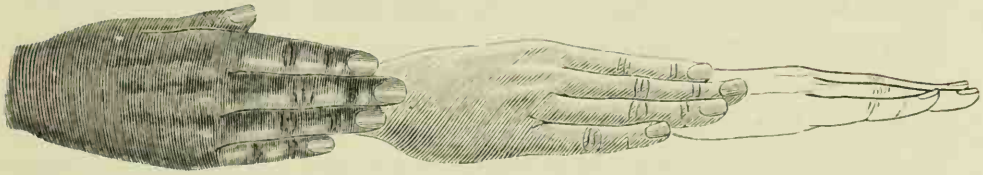

FIG. 74.—LEFT UTERINE TORSION: MANIPULATION. (SAINT-CYR.)

available, and to press against it in the opposite direction to the rolling. *The grand test and guide for the direction of rolling is the effect produced.*

If the operation is well conducted and the body of the cow moved in the proper direction, the obstetrist will find, as rotation is carried on, that the genital passage is becoming wider, until the spiral rings become effaced, so that the hand can reach the cervix and penetrate the uterus if the os is relaxed. Generally a gush of the liquor amnii from the organ announces the termination of the operation. If, however, the hand is more strongly compressed by the spiral folds as the animal is turned on its axis, and the vaginal canal is diminishing in length, it is a proof that rotation is effected

in the wrong direction. This is remedied by reversing the movement.

The number of turns necessary to reduce the torsion varies very considerably; rarely one, most frequently several revolutions—two, three, four, or more—are required.

An important precaution in this operation consists in having the hind parts raised higher than the anterior portion of the body, so as to fix the uterus by its own weight, especially when the hand cannot be passed far into the vagina. In some instances, when slow, steady rolling will not suffice, a quick or jerking roll may be successful; in other instances it has been found advantageous to place the animal on its back and roll it from side to side. Some practitioners are content to roll the cow without attempting to fix or manipulate the vagina or uterus, but rotation has to be carried on for a longer time, and the operator is not sure, unless his hand is in the vagina, whether the rolling is having a favourable or unfavourable effect on the torsion. In rare cases the rolling requires to be carried on from fifteen to twenty turns, or for more than an hour, before a successful result is obtained. The operation often entails a great deal of patience and expenditure of energy.

When the torsion is removed the cow is allowed up, and parturition will take place with or without further assistance, according to the ordinary indications. Should uterine action not speedily ensue, particularly if the os is dilated and the membranes ruptured, the fœtus must be removed by traction.

The method of rotation fails in some cases, especially where the torsion is multiple or the fœtus is dead and becomes emphysematous, causing great inflation of the uterus, or where there are plastic adhesions between the spiral folds or between the uterus and neighbouring structures.

Violet attributed his want of success in some instances to the want of resistance he could oppose to the turning round of the uterus, as the cow was rolled, when he held the feet of the calf. He therefore tied the two pasterns of the latter together, after he had brought them out of the vagina, giving the cords to assistants wherewith to exercise gentle traction. A thin piece of wood was passed between the legs of the fœtus, which served as a lever by which the creature was

made to aid in reducing the torsion, the cow being rolled half round, rarely altogether round, whenever moderate resistance was experienced. In this way the spiral constriction was made to disappear and the genital canal opened, without injury to cow or calf.

2. *Vaginal Taxis* in the standing position has been practised, but can only be of service in very incomplete torsion—quarter rotation of the uterus, for instance—when there is sufficient space in the vagina for the hand to pass through the obstacle and into the uterus. After ascertaining the direction of the torsion, the arm is introduced into the uterus as deeply as possible; if the fœtal membranes are yet intact, they must be ruptured, and the most convenient parts of the fœtus sought for. The hocks and elbows are the most suitable for manipulation. One of these must be firmly grasped, and the endeavour made by it to raise the body of the fœtus, at the same time giving it a turning movement contrary to that which would be given to the uterus in order to untwist it.

Darreau, in practising this method, employs what is called a uterine retroversor, an appliance which is rather complicated. It is adjusted to the limbs and head of the fœtus in such a way that the operator obtains sufficient leverage to turn the fœtus, and with it the uterus, so as to reduce the torsion.

The apparatus is composed of three rods (A, A′, A″; Fig. 75); of a winch (B); of a screw, with a movable screw-nut (D), pierced by three holes; and, finally, three cords (E, E′, E″), with a loop (F). The end of each rod (G), a little thickened, has a longitudinal hole (H); the other extremity (I) has a hole punched through it, and a shoulder (K). This end of the three rods is inserted into the three holes of the winch.

The apparatus is put together for use in the following manner: The cords are fastened by their loop (F) to the two pasterns and the lower jaw of the fœtus, and serve as points of attachment as well as conductors to the rods. With this object the obstetrist passes them, one by one, through the hole (H) in each rod; then, by one hand, he seizes the extremity (I), and with the second hand the other end (G); directing the latter towards the part of the fœtus to be pulled at, an assistant who keeps the cord tense passes this through

the hole (I). This done, each rod is inserted in one of the openings of the winch, the screw (C) is pushed through the middle hole, and the cords are passed through the holes in the nut (D) of the screw (C), by means of which they are made as tight as may be necessary.

The apparatus may be used either while the cow is standing or lying on its back. By turning the handle of the winch in a contrary direction to the torsion, counter-torsion is at once effected without difficulty, and without causing the animal

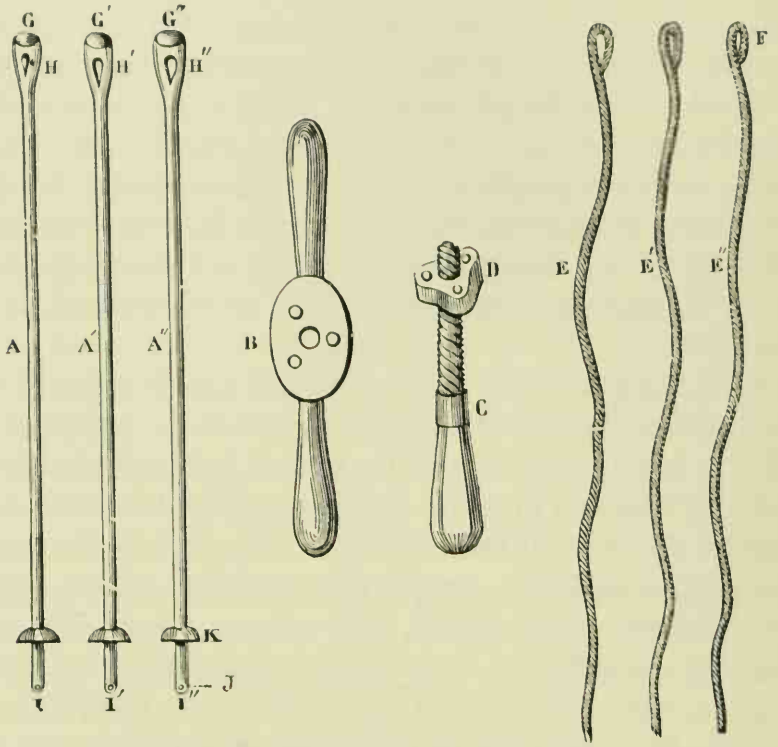

Fig. 75.—Darreau's Retroversor.

any fatigue. If the resistance is at all great, the operator entrusts the instrument to the assistant, passes his hand into the uterus, presses on the head of the calf, and in this way aids the action of the retroversor. Parturition then takes place naturally.

Obviously, the instrument can only be employed when it can be passed into the uterus. Hence the method of rotation of the cow's body has far greater advantages, and can be employed in all the cases.

3. *Abdominal Taxis* consists in opening the abdomen, and

thrusting the hand and arm into this cavity, so as to reach the twisted uterus and turn it on its axis in a contrary direction to the torsion, in order to deliver the animal by the natural passages. This method is only indicated when rotation of the cow's body has failed, and even then is not easy and not very successful. The difficulties in turning the uterus are due to its immense weight and size (from 112 to 180 pounds), its convex, smooth surface, and the limited space for manipulation. Frank has untwisted the uterus in thirteen out of fifteen cases, of which nine animals recovered.

Operation.—Saint-Cyr recommends the standing position, with the hind-quarters slightly raised. The right hind-leg is pulled back by a rope held by an assistant, to prevent the operator being kicked, while the head is tied short. An intelligent assistant introduces his arm into the vagina, in order to follow and announce the results of the untwisting. The ordinary surgical precautions are taken. The operator then makes an incision in the right flank, not too high, downwards and forwards, and from 6 to 8 inches long, through the skin, muscles, and peritoneum. The hand is then passed into the abdomen above the uterus if the twist is to the left, but below it if it is to the right; then attempts are made to put the organ in place by pressing and pushing it. If any part of the fœtus can be seized, the labour is lessened. The task is lightened also in having the abdomen raised by a sheet placed under it, and held by men on each side. Having effected detorsion, the wound is closed by suture, and antiseptic dressings are placed over it, these being retained by a wide bandage round the body. The chief danger of the operation is peritonitis. If it is impossible by this means to correct the torsion, then recourse must be had to Cæsarian section.

4. *Gastro-Hysterotomy, or Cæsarian Section.*—This operation has been recommended when the other measures described above have failed, with the object of saving the fœtus, if it be alive, or to preserve the life of the cow. Rocco has twice successfully performed the Cæsarian section in torsion of the uterus, and delivered living calves. Lemaire relates a case of torsion and rupture of the uterus in which the cow was killed, the abdomen immediately and widely opened, and the fœtus extracted from the uterus in all haste. The calf

was alive and did well. In many cases, however, the calf is dead, and there remains only the question of saving the mother—a question of economic or sentimental importance. If the operation is attempted, it is best to remove the uterus with the fœtus.

Torsion of the Uterus in the Mare.

Torsion of the uterus in the mare is a rare accident.

The *Causes* are not well ascertained, but it is not improbable that some of the causes which act in the cow will also, in certain circumstances, be effective in the mare. Rolling during colic, shortly before the accident, has been found to be the history of a few cases, one by Wolff, another by Cox.

The accident has only been seen in mares whose period of pregnancy had nearly terminated.

The *Symptoms* are generally similar to those observed in the cow. In the majority of instances the animals appear to be affected with severe colic, and attempts at micturition are frequent. The torsion is generally more forward in the body of the uterus, and the spiral vaginal folds are often not so distinct, and may even not be felt at all. Rectal exploration reveals the torsion as a thick, short, hard cord near the pubis. The posterior portion of the floating colon may be obstructed in the mare by the twist formed by the uterus and the broad ligaments, and this obstruction will, of course, prevent expulsion of the fæces.

Prognosis and Treatment.—The accident is much more serious in the mare than in the cow. A large majority of the cases terminate fatally. Five out of seven cases reported by Frank perished. The fœtus is nearly always dead. The treatment is similar to that recommended for the cow. Even if the foal is removed, rupture of the uterus is often present, and a fatal metroperitonitis results.

Torsion of the Uterus in Other Animals.

In the ewe and goat the condition is similar to that in the ox, and is treated in the same way. In multiparous animals the condition is rare, and even more rarely diagnosed.

The torsion usually affects the horns. At parturition some

of the fœtuses may be born naturally, whereas those in the affected horn in front of the twist are imprisoned and soon perish. The mother continues to strain. The imprisoned offspring may be felt on abdominal manipulation. Sometimes rupture and eversion of the uterus result.

In the sow, bitch, and cat, a diagnosis of obstruction in the genital passages may be made, and a laparotomy performed. The torsion must be reduced, and the fœtuses removed by Cæsarian section, or the horn of the uterus extirpated.

DYSTOKIA FROM MORBID ALTERATION IN THE GENERATIVE ORGANS.

1. **Utero-Vaginal Tumours.**—Tumours of the soft parturient passages are not very common in the domesticated animals. They are found in the uterus, its cornua, body, or cervix, and the vagina, or in the surrounding tissues. To interfere with parturition they must have developed chiefly after impregnation; otherwise they would have interfered with conception. When affecting the cornua of the uterus, they may interfere with the development of the fœtus and cause abortion; when present in the body, cervix, or vagina, the tumours sometimes interfere with normal parturition. Occasionally, with malignant growths, a vaginal discharge will indicate, before parturition, some abnormality of the genital passage, and vaginal exploration will confirm it.

These tumours vary considerably in size, nature, and consistence; some are attached by wide bases, others are pedunculated. These tumours are carcinomata, adenomata, occasionally sarcomata; also papillomata, lipomata, myomata, granulomata.

The distinction between them can only clearly be made out by a microscopic examination of sections from the tumour.

Treatment.—The diagnosis of the tumour is made in a case of dystokia by a vaginal examination. When the tumour is pedunculated and lies as an obstruction in the vagina or uterus, the pedicle should be ligatured and the tumour cut off, or the growth removed by ecraseur. Sometimes the neck of the neoplasm is so small that it may be torn off or removed by the finger-nail. That will chiefly be necessary when it is very far forward.

The most difficult tumours for treatment are those which are hard and sessile. Sometimes this formation has only a loose connection with the subjacent tissues, and, if the mucous membrane around the tumour is incised or the tumour itself cut into, it is often possible to enucleate it in whole or part by means of the fingers. As a rule neoplasms developed on the labia offer no obstacle to birth; should they chance to do so, however, it is easy to remove them with the scalpel. If œdema should result from the operation and cause obstruction to birth, then it may be combated by scarification.

Occasionally tumours are so extensive, so large, and involve such a large portion of the genital passage, or affect the bladder or neighbouring structures, that they are inoperable. Sometimes they affect the cervix and interfere with the opening of the os. In the latter case it may be necessary to act as in induration of the cervix uteri. In the former cases two courses are open to the obstetrist—embryotomy or Cæsarian section. Embryotomy can only be carried out when there is sufficient room in the genital canal for manipulation. Cæsarian section should be performed where the progeny are to be saved, in the larger animals frequently with the sacrifice of the mother.

Hæmatomata of the vagina or vulva occasionally occur as obstacles to parturition. They are caused by rupture of blood-vessels and the escape of blood into the connective tissue around the vagina. It is necessary to open them freely, to evacuate the blood to render parturition possible, and immediately after the act is over to plug the canal or apply some styptic, such as perchloride of iron, or use adrenalin, to arrest any hæmorrhage.

Serous Cysts have been observed in the vaginal mucous membrane, and even in the uterus, of the mare and cow. The vaginal cysts are frequently the size and shape of a pear. They are attached to the mucous membrane by a very narrow pedicle, and in some instances appear between the labia of the vulva when the animal is reclining, but disappear again into the vagina when the standing posture is assumed; though occasionally they are so large that they cannot return without assistance. The cyst is smooth and transparent, and contains a clear limpid serosity, in which albuminous flakes are often observed.

Such cysts are not likely to retard parturition; occasionally they are so large as to prove troublesome obstacles to delivery. Such cysts must not be mistaken for the fœtal membranes or an everted bladder. A careful examination should obviate such an error. The treatment of a cyst which interferes with parturition is to puncture it and let the contents escape. The collapsed wall of the cyst will prove no barrier to the expulsion of the fœtus. Removal of the cyst wall at its pedicle may be effected after parturition.

2. **Vaginal Cystocele: Hernia of the Bladder into the Vagina.**—Dystokia from the existence of a vaginal cystocele is a somewhat rare accident, and only a few instances are recorded in the mare and cow.

Hernia of the bladder may occur in two ways—(1) Inversion: When empty it may, by spasmodic contraction of its walls, evert itself—the mucous membrane becoming external, and the peritoneal coat internal—and thus turned outside-in it may pass through the meatus urinarius into the vagina. (2) Prolapsus vesicæ: It may, without being everted, escape into the vagina by an old or recent fissure in the floor of the passage. Most of the cases occur during parturition and when the animal is straining violently, whereby a portion of the contents of the abdomen and uterus are pressed against the bladder, and may thus produce its inversion. The short, straight, wide urethra in the mare and cow renders the bladder liable to inversion.

In inversion we find a somewhat hard, red tumour with a corrugated surface, and attached to the floor of the vagina by a short, narrow pedicle. The meatus urinarius cannot be found on the floor of the vulva, and on the soft, pulpy surface of the tumour will be observed two small openings (the openings of the ureters), from which urine with its characteristic odour continually escapes. This fluid may even be thrown out with a certain degree of force during the labour pains.

In prolapse there is found in the vagina a pyriform, smooth, fluctuating tumour, attached to the floor of the canal by a pedicle more or less wide, and beneath which the meatus urinarius can be seen or felt. It rapidly increases in size with the accumulation of urine within it. The fundus of the bladder is directed backwards towards the vulva, and the

urethra being doubled on itself, the urine is prevented from escaping. The swelling will thus sometimes form a very serious obstacle to parturition. The covering of the hernia varies in colour according to the length of time which has elapsed since the accident. Sometimes it becomes gangrenous and sloughs. By a careful examination of the neck of the swelling, the meatus urinarius, and ureters in inversion, cystocele should be distinguished from the fœtal membranes.

Treatment.—In prolapse the catheter must first be passed, and the bladder emptied of urine. Puncture with a small trocar and cannula has been practised when catheterism is not possible; the trocar is inserted obliquely through the upper part of the viscus, and the urine removed. The serous covering of the bladder must be carefully washed with a mild antiseptic lotion, and then it may be returned to its normal position. If the rupture of the vagina can be reached, an attempt should be made to suture the wound.

In cystic inversion, the mucous membrane must first be washed. Should the animal be straining violently, a sedative, such as chloral hydrate, should be administered. Then the sides of the bladder should be gently pressed on with the left hand, while the right hand presses forward the fundus until it gradually recedes within the meatus urinarius. Last of all, the catheter may be carefully introduced to return it to its position.

Sometimes the bladder is no sooner replaced than it is again everted, and this repeatedly. Pencilling around the meatus with nitrate of silver, dashing cold water on the vulva, and walking the animal quickly about, have caused its retention. Should the distended inverted bladder be immediately in the tract of the fœtus, and the expulsion of the latter urgent, if the bladder cannot be returned before birth, it must at least be emptied, to allow the young creature to get through the vagina. As the fœtus passes over the bladder, the viscus should be protected from injury by the fingers. Where the bladder wall becomes gangrenous, amputation should be considered. In prolapse there is always a very serious danger of peritonitis.

3. **Rigidity or Spasm of the Cervix Uteri.**—Rigidity or spasm of the cervix uteri is not uncommon among animals—most

frequent in the cow, next in the goat, and very rare in the mare. It is more common in nervous, irritable animals and in primiparæ, but is sometimes noted in old, emaciated, and debilitated animals.

The cervix in this condition feels prominent and rigid, while the os will hardly admit a finger, if at all. The condition is due to one of two causes—(1) spasm of the circular muscular fibres, and (2) want of muscular effort in the uterus to dilate the os uteri. In practice it is not possible to distinguish two varieties according to the cause. In some cases the rigid condition of the cervix is due to malpresentation or malposition of the fœtus in the uterus.

Symptoms.—The symptoms vary somewhat. In one case there may be at first nothing unusual noted, save that the duration of parturition is very long, and may extend over two or three days, and yet no progress is being made towards delivery. In some instances the animal loses condition, exhibits indications of exhaustion, and gradually sinks; or it appears ill for some days, then rallies and assumes its ordinary appearance. In another case the creature manifests an unusual amount of excitement at first; there is agitation, straining, and symptoms of colicky pains; the animal looks frequently back at the abdomen, lies down, and gets up again; sometimes during the throes the vagina is protruded beyond the vulva, and appears as a large, red mass.

The *Diagnosis* is made by a vaginal exploration. The os will be found more or less contracted, so that scarcely one finger can be introduced into it, while the cervix is very much elongated. If the finger can be inserted, it will be found that there is neither deformity nor morbid induration.

The *Prognosis* of simple rigidity or spasm of the cervix uteri, provided there is no alteration in its texture, is usually favourable. In many cases Nature overcomes the obstacle, and in the course of one, two, or three days of more or less severe and exhausting labour delivery is effected spontaneously, and the animal and its progeny are none the worse after a short time.

It is, however, advisable to examine the animal, as soon as any serious delay in delivery is noted, to find out if the fœtus is dead or if it is in an abnormal position. Under these con-

ditions more especially, assistance in parturition is imperative.

Treatment.—Active intervention is not necessary in the cow for some hours after the commencement of parturition—say five or six hours.

When labour is unduly prolonged, without any progress being made in parturition, and the "pains" are energetic, then intervention may be counselled to relieve the expulsive efforts and dilate the os. About a drachm of the green extract of belladonna should be smeared round the cervix or introduced into the os to dilate the latter; blankets or sacks wrung out of hot water should be applied every ten minutes over the loins of the large animals to prevent straining, and some nerve sedative—such as chloral hydrate—should be administered by the mouth. Chloral hydrate relieves the distress without interfering with the contractions of the uterus.

The local application of belladonna combats the spasm of the cervix uteri and permits dilatation of the os; usually one application suffices. This action is denied by some authorities. Possibly some of the local anæsthetics—such as stovain, cocain, eucain—may be used successfully for the same purpose.

Where these means are not sufficient to dilate the os, recourse is had to mechanical dilatation. This is always a laborious and tedious process. The hand and fingers, well lubricated, are introduced in the form of a cone towards the os, if they cannot be passed into the os uteri in this shape, then the insertion of one finger may be attempted, followed by a second, and so on, until the hand has been pushed through. Such a manipulation requires great patience, and dilatation may not be effected until after several trials at intervals of a few hours. The further dilatation of the canal may be brought about by careful traction upon the fœtus. As in natural dilatation of the os, the force applied to the cervix should be from the front rather than from behind.

Mechanical dilatation of the os by sponge tents, uterine dilators, and uterine douches, have also been recommended. Sponge tents are made from conical pieces of sponge, wrapped round with twine so as to make them compact. Before use

the twine is removed and the sponge inserted into the os, the base towards the vagina, and prevented from passing into the uterus by a piece of cord in the vagina. The sponge soon absorbs moisture, and enlarges, and in enlarging dilates the os; it also detaches the membranes and induces labour, and acts as a foreign body, so increasing expulsive efforts. A sponge tent is also prepared by saturating a sponge with a solution of gum-arabic, then rolling twine around it, and leaving it to dry for some days. It has this advantage, that it does not soften in its passage through the vagina to the os.

Another procedure consists in dilating the os by means of a fiddle-shaped indiarubber bag. The bag in an empty condition is introduced into the os by means of a whalebone

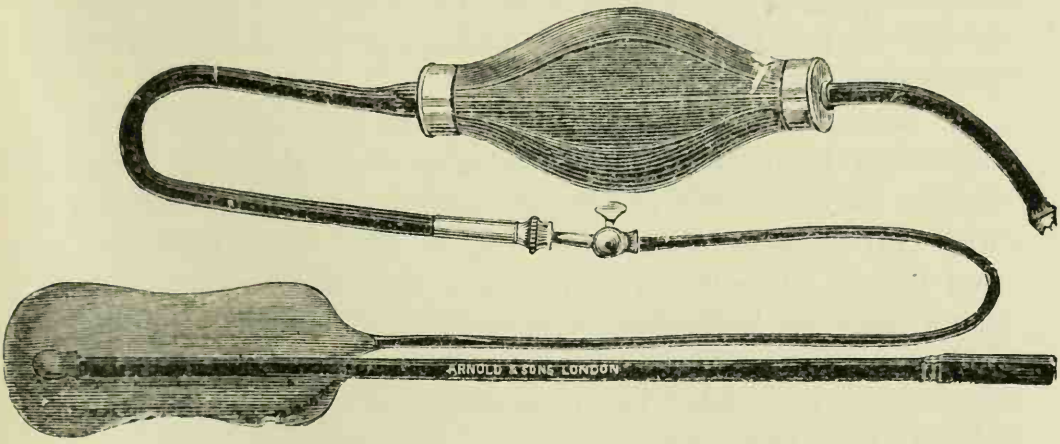

FIG. 76.—UTERINE DILATOR.

sound or director, which fits into a small pocket at the side; it is pushed through the canal until the pocket end projects into the uterus; then water is steadily injected into it by means of the tube attached to the other end. When filled with water the bag remains in the os, in consequence of the middle portion being narrower than the two ends. The disadvantage of it is that it cannot be passed into the os unless this is permeable to two or three fingers.

Another means of dilating the os is the uterine douche, and consists in the application of a strong jet of lukewarm water upon the cervix uteri for ten or fifteen minutes, at intervals of two or three hours, until the desired effect is produced. This douche has not been much employed in veterinary work.

Large forceps, similar to a pair of blacksmith's tongs, have also been used in urgent cases. The jaws of the forceps are protected with leather or tow, and lubricated. They are introduced closed into the os, and then gradually opened, and so the desired widening of the passage is brought about.

In some cases in which the spasmodic action of the uterus is irregular, and leads to occlusion of the os, it might be advisable to resort to anæsthesia with chloroform to produce semiconsciousness and permit of easier manipulation, and perhaps relieve the spasm of the cervix uteri. In the majority of the cases, after dilatation of the os, birth will take place without further assistance being required. If there appears to be atony of the uterus or the mother is exhausted, or if the fœtus is dead or in a faulty position, then it will be necessary to afford assistance in parturition by adjustment and traction.

4. **Induration of the Cervix Uteri.**—Induration of the cervix uteri has been observed nearly always in the cow. The texture of the cervix is altered, becomes fibrous or affected with sarcoma or carcinoma. It is hard and thickened, and the os uteri is very small and cannot be opened. In some cases the induration is congenital and noted in heifers, but as a rule it is due to injury or disease in the cervix, and seen more frequently in old animals or those which have already been bred from.

Symptoms.—In the great majority of cases the existence of induration is not suspected until parturition sets in, when the labour pains, which may continue for a long time, attract more than ordinary attention, as birth does not take place. In some cases, when the cow lies down because of the straining, the undilated cervix appears as an irregular-shaped, nodulated kind of tumour between the labia of the vulva.

As a rule a vaginal exploration is necessary to ascertain the cause of delay. The cervix is found as a more or less dense, irregular, nodulated tumour, which in some cases feels as hard as wood, in others present a rugged, soft, and ulcerated surface. Some obstetrists describe solid, unyielding, transverse rugæ in the os, but these are also noted in spasm of the cervix. In every case the os is deformed and irregular, and is contracted so that only one or two fingers may be

inserted. Occasionally the fœtus may be felt through it. When the cervix is ulcerated, the hand will be found covered with blood after the examination.

Diagnosis.—It is not always easy at first to distinguish induration from spasm, and the distinction is arrived at after treatment. In spasm the os is soon dilated, whereas in induration very often the cervix is deformed, and even mechanical methods of dilatation often fail.

Prognosis will depend largely upon the degree and extent of the alterations in the cervix. If the induration is localized, it may cause only a slight constriction of the opening, and parturition, though difficult, may be accomplished without assistance. Sometimes even then, laceration of the cervix results from its unequal dilatation. When the induration is extensive, the condition is always serious, and is often followed by fatal results. The uterus may be ruptured through the efforts at delivery.

Treatment.—In the early stages, the treatment for dilatation of the os as described for spasm should first be tried. Where this is of no service, delivery must be affected by one of two serious operations:

(*a*) *Vaginal Hysterotomy* consists in making one, two or three antero-posterior incisions on the upper and lateral walls of the os uteri with a knife, sufficient to bring about the required dilatation. It is possible by this operation to save both mother and fœtus. When the os has been sufficiently dilated for the introduction of the hand and arm into the uterus, then the fœtus should be placed in position for extraction and drawn towards the cervix. If the os will not admit portions of the fœtus, then more incisions may be made in the cervix without displacing the young animal. Afterwards the passage should be lubricated, the extremities of the fœtus presented, secured, and the fœtus cautiously extracted. Bad sequelæ are fatal hæmorrhage resulting from the incisions, rupture of the uterus, and metroperitonitis. Donnarieix states that he has performed vaginal hysterotomy in sixty cases of induration of the cervix uteri, and of these only one died, though the cause of death was not ascertained. For further details see Obstetrical Operations. Of course, recovery must always be doubtful if the disease of the cervix

is of a malignant nature, as the operation and the irritation, caused by the extraction of the fœtus, will in all probability hasten its progress.

(*b*) *Cæsarian Section* in the cow should only be employed when all other efforts are hopeless. It is carried out in the hope of saving the fœtus. It is an exceedingly formidable operation if the cow's life is to be saved; and even if it is, further breeding from the animal is inadvisable.

5. **Complete Obliteration (Atresia) of the Os Uteri** has been observed but rarely in the mare, cow, and sheep. It cannot be congenital, as the canal must be open during impregnation It most commonly results from the development of cicatricial tissue from wounds or injuries sustained in previous pregnancies.

The symptoms are similar to those of spasm of the cervix uteri, but on introducing the hand into the vagina the os cannot be found, or only appears as a small imperforate depression. The fœtus can be felt in the uterus.

If relief is not afforded, the mother may die from exhaustion or rupture of the uterus. Sometimes, in the latter case, the fœtus passes into the abdomen, and the mother survives for a longer period, constituting a case of extra-uterine pregnancy. Occasionally the labour pains subside, the fœtus dies and undergoes desiccation, while the mother does not appear at all amiss, and the condition is only discovered at a post-mortem examination.

Treatment.—If the os can be found, the finger or a metal catheter may suffice to puncture it, the pressure being gradual and the movement semi-rotatory. Afterwards the opening must be enlarged by performing vaginal hysterotomy.

When the cervix cannot be found, the portion of uterus which protrudes into the vagina must be incised, and the fœtus removed by this artificial opening. To ascertain the relation of the vagina with the uterus, a rectal examination should be made. For the operation Hubert recommends a convex bistoury, the blade of which is covered to within a few lines of its point. The instrument is to be directed to the part where the os is supposed to be; then the coats of the uterus are to be carefully incised to a small extent, layer after layer, until the escape of the liquor amnii announces that the

fœtal membranes are opened. The small slit thus made is to be enlarged by a probe-pointed bistoury, the enlargement being either crucial or T-shaped. Then the fœtus is to be extracted. Where this fails, Cæsarian section must be performed.

6. **Vaginal or Vulvar Constriction or Atresia.**—This condition may exist previous to impregnation, but to such an extent as to offer no obstacle whatever to that act; or it may become developed in the interval between impregnation and parturition. Incomplete congenital stenosis or constriction is not at all uncommon in young animals, in which the vulva and vagina are often so constricted and inelastic that during copulation they are injured, and cicatrization resulting from the injury still more diminishes the calibre of the passage during pregnancy.

Acquired stenosis is generally the result of certain diseases or injuries, such as inflammation, suppuration, ulceration, and laceration, often due to difficult parturition. Ulcerated surfaces adhere or hard cicatrices form.

Treatment.—In mild cases it may be sufficient to lubricate the passage well, dilate it with the hand, and then exert moderate traction on the fœtus.

In severe cases incisions must be made on the walls and roof of the passage, or adhesions broken down, to increase its calibre. These incisions must vary in depth and number according to the thickness of the vaginal wall and degree of constriction. Then the delivery of the fœtus must be assisted by traction.

7. **Persistent Hymen** is only occasionally met with as a slight obstacle to parturition. It has been recorded in heifers only in a few cases. This hymen consists of a short band or imperfect septum, and may easily be ruptured with the finger or incised about its middle with a guarded knife.

8. **Anomalies in the Placenta** are very exceptional in animals. According to Cox, *scirrhous chorion* is occasionally noted. The chorion becomes so thick and leathery that, although the placenta is separated from the uterus, rupture of the chorion by the obstetrist is necessary before the fœtus can be expelled.

9. **Morbid Adhesion between the Fœtus and Uterus.**—Adhesions between the amnion, chorion, mucous membrane

of the uterus, and the fœtus, have been remarked in a few cases by Rainard, Nemo, and Naylor. They are recognized in uterine examination by the hand in a case of dystokia. The adhesions with the fœtus are discovered, and can be broken down with the fingers. If they are too strong, then a bistoury is used to incise the adhesions, the "crutch" or "repeller" being used, if necessary, to keep the weight of the fœtus away from the part where the separation is being effected.

10. **Stricture or Occlusion of the Uterus by External Bands or Membranes** is extremely rare, and only described in the cow, and appears to be due to hernia of the uterus through the great omentum or mesentery. A constriction occurs at the rupture of the peritoneal fold, which may involve the body or neck of the uterus or the vagina, and prevents the passage of the calf during parturition. The only treatment that can be recommended is Cæsarian section.

CHAPTER VII

FŒTAL DYSTOKIA

Obstacles to parturition due to the fœtus are much more numerous and frequently met with than those offered by the maternal organs.

The obstacles which the fœtus may offer to birth are, for convenience of study, divided into two groups: (1) Those resulting from some physical condition of the young creature itself; (2) those resulting from the more or less irregular manner in which it is presented at the pelvic inlet. Of course, it must be remembered that difficult parturition due to the fœtus may be owing, in some instances, to a combination of two or more of these obstacles.

GROUP I.—OBSTACLES INDEPENDENT OF PRESENTATIONS AND POSITIONS.

The following synoptic table shows at a glance the numerous and varied conditions which may be classed in this group. The frequency and importance of each of them will afterwards be noted:

Dystokia from
- Umbilical cord.
- Excess in volume.
- Excess in growth of hair.
- Anomalies and diseases of membranes.
- Abnormal quantity of placental fluid.
- Diseases
  - Hydrocephalus.
  - Ascites, anasarca, and hydrothorax.
  - Emphysema.
  - Polysarcia.
  - Contractions.
  - Tumours.
- Monstrosities.
- Multiparity.

VARIOUS EXTRAORDINARY CAUSES.

The Umbilical Cord.

Anomalies in the umbilical cord are a very rare cause of dystokia. As a rule the umbilical cord in the domesticated animals is short, and hence the coiling of it around some part or parts of the fœtus is seldom observed. Occasionally the cord has been found coiled round the neck, especially when the position of the fœtus is abnormal and the head is bent towards the flank. It has also been noted encircling the flank and one or more limbs. Daubenton has remarked the frequency of leg coils in sheep. This condition is more likely to cause death of the fœtus by asphyxia than dystokia, by stretching the bloodvessels of the cord and checking the blood-supply.

Diagnosis and Treatment.—When labour is protracted and fatiguing, and nothing can be found in the passage or fœtus to explain the delay, then a careful examination should be made of the cord to find whether it is relaxed or tight or encircling any part of the body. In the latter case an attempt should be made to undo the coiling of the cord. Should the attempt fail, then the cord must be cut with bistoury or scissors some distance from the umbilicus, and delivery effected as quickly as possible, to avoid asphyxia and death of the fœtus.

Excess in Volume of the Fœtus.

Excess in volume of the fœtus due to normal or abnormal development of either the whole or only part of its body is a not infrequent cause of dystokia in the domesticated animals, rendering spontaneous birth more or less difficult or altogether impossible, notwithstanding the healthy condition of the maternal organs, the regularity and energy of the uterine contractions, and the favourable position of the fœtus.

Causes.—Several causes may be in operation.

1. *Prolonged Gestation.*—Occasionally a fœtus is retained without injury for some time, weeks it may be, beyond the period usually allotted for its expulsion, and its development

is increased beyond the normal size. There are instances recorded of the fœtus of the cow and mare weighing 117, 165, 189, and 200 pounds, whereas under ordinary circumstances the fœtus weighs only 56 to 80 pounds at birth. This, however, is not a common cause of dystokia. In many cases where the gestation is prolonged, the fœtus is no larger than normal, and parturition is spontaneous.

2. *Reduced Number of Fœtuses.*—With multiparous animals, when the number of fœtuses is smaller than usual, as with the bitch which has only one or two instead of five or six, the size is often increased to an abnormal degree, and assistance is required at parturition.

3. *Disproportion in Size between Male and Female.*—There can be no doubt that a disproportion in size between male and female, in many instances, exerts a marked influence in this direction. More especially is this the case in crossing with different breeds. Sometimes all the calves by certain bulls are remarkably large and are responsible for difficulty in calving.

Small bitches lined by large dogs frequently experience difficulty at parturition, and often perish.

Delorme, quoted by Rainard, says that he has known a certain number of Camargue ewes die every year through non-delivery, after having been put to Dishley rams which were much larger than the native sheep. In many instances dystokia is due to exaggerated development of some particular region of the fœtus, and more especially of the head—a peculiarity derived from crossing or breeding from a male possessing this character. In the bitch this is most commonly remarked. Price mentions that a grazier in 1804 put some large Kentish rams to his flock of small ewes. In the following lambing season he had to give assistance to all the ewes, and lost 12 of them. In 1806 he had the same difficulty, and lost 9 ewes in a flock of 250 from this cause. Cartwright of Whitchurch has frequently known of some bulls getting calves with very large heads, and causing great difficulty in calving. Rueff and Baumeister refer to small native cows of Würtemberg which, when crossed by the original Simmenthalern bull, have often difficult labour, as the latter breed has often a large head.

In quite a large number of species, however, the mating of small female animals with larger males has not proved a source of difficult parturition, provided there was nothing unusual in the proportion of any region of the latter. Melingié, in order to form the breed of sheep known in France as the Charmoise, coupled the small Berrichonne sheep with the great New Kent rams, and yet in 2,000 births only 1 was difficult. Nathusius asserts that in the cross between the small merino sheep with the huge English rams he has observed fewer difficult births than in flocks composed solely of merinos. Saint-Cyr also states that he has often seen little "Bressanne" mares, put to big Percheron or Anglo-Norman stallions, foal without difficulty at the ordinary period. The small female ass, also, coupled with the horse stallion rarely suffers during birth.

4. *Breeding from Immature, Undeveloped Females* is almost certain to produce laborious births, because the genital canal, and particularly the pelvis, is not sufficiently developed for the passage of the fœtus. This is often noted in heifers calving at one and a half years old or younger.

5. *Influence of Food.*—The manner or kind of feeding appears to have very little influence in causing an excessive volume of the fœtus and a consequent difficult parturition.

Diagnosis.—The diagnosis of excessive volume of the fœtus can only be established as a rule at parturition. The size of the maternal abdomen or the increase in weight of the mother during pregnancy is a very deceptive sign.

At parturition, when, in spite of energetic and sustained uterine contractions, labour is protracted and does not advance, and when, on exploration, the pelvis and genital organs are found to be well formed and normal, the os dilated, the fœtus in a favourable position and not malformed, it may be suspected that the obstacle to birth is dependent on the large size of the latter. A closer and more careful examination of the fœtus will probably confirm this suspicion.

With the bitch, the principal obstacle is generally the head of the puppy, which, when it is large, is lodged at the entrance to the pelvic inlet. In animals such as King Charles spaniels, pugs, bulldogs, where the muzzle is short

and the forehead large and dome-shaped, parturition is oftentimes extremely difficult. With the cow, also, the head of the calf is sometimes the chief impediment, and is often so firmly wedged in the bony portion of the pelvis that it can scarcely, even with much force, be moved backward or forward.

With the mare and cow, the anterior portion of the body of the fœtus—chest and shoulder—generally forms the greatest obstacle to parturition. In some cases in the mare the croup also interferes with delivery. Harvey states that anomalies of the fœtus, causing arrest at the pelvic inlet in cows, are of three kinds, which may occur together or separately, viz.: (1) An extremely wide pelvis, prominent ilial tuberosities and hip joints; (2) excessive development of the stifle joints; (3) in large, fat, fleshy calves the soft tissues of the thighs, etc., are squeezing in a way which cause bagging in front of the pelvic inlet, and thus determine a ball-valve action.

Prognosis.—When the protracted parturition is noted, it generally happens that the membranes have ruptured, and the liquor amnii has escaped at an early stage; consequently the maternal passage is dry and tenacious, and perhaps swollen and irritated; while the fœtus, no longer protected in its hydrostatic bed, is directly exposed to the uterine contractions, and in proportion as these are energetic, so does it the more rapidly succumb. The mother in turn becomes exhausted, through unavailing efforts at expulsion, and, if judicious assistance is not opportunely rendered, is not long before it perishes.

In the mare the foal most frequently dies. This form of dystokia is not common in this species.

In the cow there is great hope both for mother and calf, especially if the excess of volume is not too great.

In the small multiparous animals it is often necessary to resort to Cæsarian section because of the difficulty of applying traction and of manipulating the fœtus.

Indications.—The indications are similar to those given for constricted pelvis.

1. *Extraction of the Fœtus Entire.*—If the fœtal fluids have escaped, warm emollient fluids, as linseed-tea (made by mixing 1 pound of linseed-tea with 2 gallons of warm water,

and straining through muslin), should be injected into the vagina and uterus, and, if necessary, the portions of the fœtus presenting may be lubricated with oil or unsalted lard. The hand should then adjust the fœtus if this is requisite, and attempts be made to extract it by judicious traction-cords on the head and limbs, or forceps in the bitch.

It must be carefully borne in mind that a medium degree of force well directed is often more effective than severe traction misdirected and inopportune.

2. *Embryotomy.*—When forcible extraction is deemed impossible or dangerous for the mother, the only alternative is embryotomy, to be described later on. If the head is the obstacle, then it must be removed by decapitation; if the body, it must be taken away piecemeal. In the bitch, the parts must be removed piecemeal by crushing and traction with the forceps. In many cases in the small breeds, manipulation through the vagina is impossible.

3. *Cæsarian Section, or Hysterectomy*, is the last resort, but, to be successful, must be performed as early as possible.

Excess in Growth of Hair is a very rare cause of dystokia. Eberhardt of Fulda records a case in a cow in which the dystokia was easily overcome by lubrication of the fœtus and passage and by suitable traction.

Anomalies in, and Disease of, the Fœtal Membranes are extremely uncommon obstacles to birth.

Rainard mentions an instance in which a hairy band or cord attached the envelopes to the head of the fœtus, a shred of skin having probably been partially detached from the forehead, from a kick received by the cow some time previously, and, becoming fixed to the membranes, formed an obstacle to birth.

Vincent describes a very interesting case, in which the skin covering the joints of the first and second phalanges of the right fore-leg of the fœtus had contracted close and strong adhesions with the envelopes, and these with the uterine mucous membranes. Birth could not be accomplished until the adhesions were broken down with the fingers.

Difficulty in parturition in the cow is sometimes experienced from the envelopes being torn in several places, and the head

or limbs, or both, passing through these fissures. In such cases the entangled parts of the fœtus must be sought for, released, and brought into a favourable position by tearing or cutting through the obstacles.

DISEASES OF THE FŒTUS.

Hydrocephalus.

Hydrocephalus signifies dropsy of the brain. A considerable quantity of fluid accumulates in the cranium of the fœtus, leading to a proportionate enlargement of that region. This diseased condition is not at all uncommon in the bovine and equine species. It is recognized by a more or less exaggerated volume of the cranium. In some cases

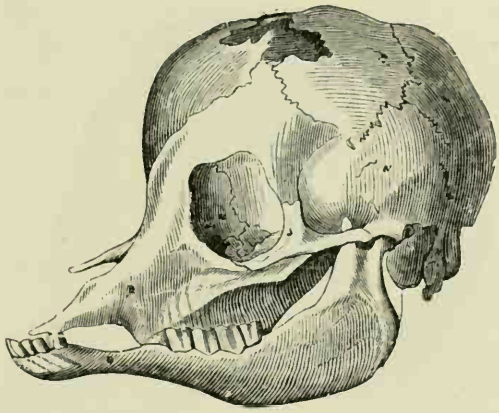

FIG. 77.—SKULL OF A HYDROCEPHALIC CALF. (SAINT-CYR.)
The cranial bones are partially destroyed and defective.

the forehead rises almost at right angles to the face, and reaches an extraordinary height. The hydrocephalic tumour varies in shape as well as in volume. It is sometimes quite globular; in rare cases it is narrow, but excessively protuberant, involving only a part of the cranium; at other times it is bilobular, and the divisions may be equal or unequal in volume.

Sometimes in the calf the diameter of the tumour is more than one foot. The tumour is soft and depressible in parts, hard and resisting in others, owing to the alteration and separation in the cranial bones. Frequently these bones—especially the frontal, temporal, and parietal—are considerably deformed and separated, and in places no thicker than tissue-paper. At places where they are separated, the dura mater

adheres closely to the skin. Sometimes in the calf the roof of the cranium is entirely absent. The skin over the tumour is always intact, but very thin, and the hair over it is at times longer than usual, making the animal appear as if it wore a high fur cap.

The fluid in the tumour is limpid, colourless, or slight yellow, and varies in quantity from 2 pints to 2½ gallons. The fluid develops in the ventricles of the brain, and the cerebral hemispheres over them become atrophied by pressure.

The *Cause* of the condition is unknown.

The condition does not affect adversely the development of the fœtus, which is frequently full grown at birth. It

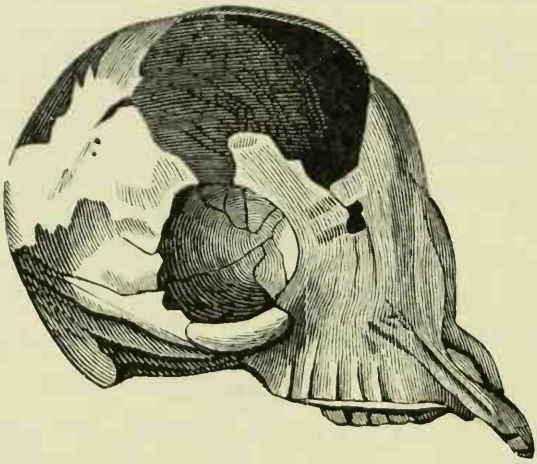

FIG. 78.—SKULL OF A HYDROCEPHALIC FOAL. (SAINT-CYR.)
The cranial roof is deficient at the sides.

usually dies during birth or soon after—after one or two respirations. Exceptionally such creatures have lived for a few days, but rarely recover, even in the mildest form of the malady.

The birth of a hydrocephalic fœtus often takes place spontaneously, though perhaps only after much straining Sometimes with expulsive efforts the tumour ruptures, and the fluid escapes by the ears, nostrils, and eyes.

Diagnosis.—When causing dystokia in the anterior position, the large spherical cranium can easily be felt on a vaginal examination It is necessary first to identify the head by the tongue, eyes, ears.

In the posterior presentation, hydrocephalus is usually only recognized when the body of the fœtus is already beyond the os, and even the vulva, and a difficulty is discovered and the cause sought for. Manual exploration is then difficult in passing forwards between the fœtus and vaginal wall.

Indications.—When the hydrocephalus is not considerable, judicious traction will often accomplish delivery. Where this cannot be effected, the tumour must be opened at its softest point with a knife or trocar, and the fluid allowed to escape. The head then collapses, and delivery is easily brought

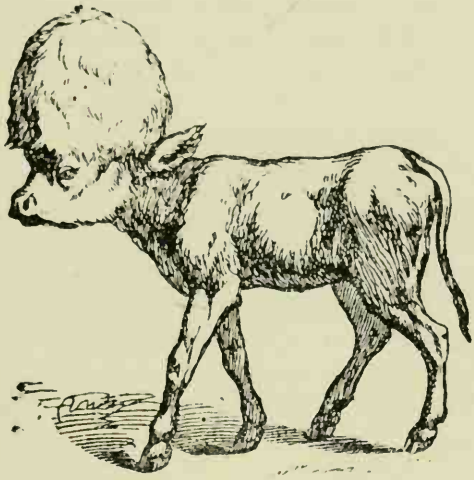

FIG. 79.—CALF AFFECTED WITH HYDROCEPHALUS. (RUEFF AND BAUMEISTER.)

about. In a few cases it may be necessary to reduce the size of the head still further by removing portions of the cranial bones with a long chisel or bone forceps.

Ascites, Anasarca, and Hydrothorax.

Ascites (dropsy of the peritoneum) and anasarca (dropsy of the tissues beneath the skin) are comparatively rare. Anasarca has been observed in the foal, calf, and kid, and ascites chiefly in the calf. Hydrothorax is often combined with ascites. None of these fœtuses are born alive.

The *Cause* of this dropsical condition is not well ascertained. It is believed in some cases to be due to uterine dropsy of the mother, derangement of the fœtal circulation, or disease of such organs as the kidneys.

The amount of difficulty met with during delivery in these

cases will depend upon the quantity of fluid effused into the abdominal cavity, chest, or superficial connective tissue.

Diagnosis.—The nature of the obstacle can only be ascertained by vaginal and uterine exploration. The great size of the abdomen in ascites, the distension of its walls, and the fluctuation on pressure, should reveal the state of affairs. In the anterior presentation the head, neck, and fore-limbs, may have passed out of the vulva before any difficulty is experienced. Then the hand must be passed along the passage at the side of the fœtus to discover the cause of the difficulty.

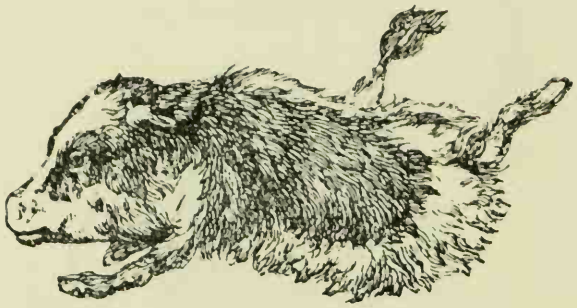

FIG. 80.—ANASARCOUS FŒTAL CALF. (FRANCK.)

In posterior presentation the hips of the fœtus enter the pelvic canal, and then remain stationary.

When the dystokia is due to anasarca, this will be distinguished by the general roundness of the surface of the body, owing to the presence of subcutaneous fluid, and by the œdematous sensations communicated to the fingers by pressure.

Indications.—In ascites, where traction fails, the fluid must be released from the abdominal cavity. This may be done by incising the abdominal wall with a guarded knife. In the anterior presentation it is often necessary to remove a fore-limb, remove the first two ribs, eviscerate the thorax, and puncture the abdomen through the diaphragm. When the fluid escapes, the abdomen collapses and delivery is easy.

In anasarca deep incisions may be made to get rid of the

fluid. As a rule the indications here are as for excessive volume of the fœtus.

An extremely rare cause of dystokia is due to *congenital occlusion of the urachus* followed by a great accumulation of urine in the bladder and great distension of the abdomen. The diagnosis and indications are as for ascites.

Bulldog Calves are peculiar anomalies met with in certain breeds of cattle. In France they are found among Normandy cattle; in the British Isles they are very frequent among Dexter Kerrys. In some herds they are a source of serious loss to their owners. The calves are called "bull-dog" because of the appearance of their heads. The head is rounded, the lower jaw protruded in front of the upper, the neck short, the body is very thick and stout, and the limbs are extremely short, and often project as small stumps from the side of the body. The cause is rather obscure. The condition is described as achondroplasia, from the imperfect development of the skeleton. It was once thought to be a form of cretinism, but in some of these calves the thyroid glands have been found to be normal. The condition is frequently associated with in-and-in breeding. These calves are frequently smaller than normal, and only occasionally cause dystokia. In a few cases they are very large, and the cow requires assistance at parturition. The same treatment will then be required as for excessive volume of the fœtus. More commonly dystokia is due to abduction or flexion of the limbs. In these cases the position of the limbs must be rectified, and delivery assisted by traction. Even if the calves are born alive, they are of no value.

As a preventive measure, all breeding with close relations should be stopped, or thyroid administered during subsequent pregnancies to cows in which this accident has occurred. It cannot be claimed that there are any observations to show whether these recommendations have been tried, or if tried have been attended with success.

Emphysema.

Emphysema is observed only after death of the fœtus. It is a form of putrefaction, with the formation of gases which accumulate in the tissues under the skin. In the course of two or three days, sometimes within twenty-four hours, after the first signs of labour are noted, the fœtus becomes softened and decomposed, and the subcutaneous connective tissue is distended with gases. Sometimes this distension causes rupture of the fœtus.

On approaching an animal in which the fœtus is emphysematous, a powerful stench will be noted coming from the vulva, the mucous membrane of which is of a yellowish-red

tint. On introducing the hand into the uterus, the inflated fœtus crepitates on pressure, and the gas can be moved beneath the skin; the hair is loose and easily removed; the skin itself is often dry, and the fœtal fluids small in quantity. Gases are sometimes formed in the fœtal membranes.

Bossetto mentions a curious case in a cow in which gas escaped through the vagina after the rupture of the fœtal membranes, and became ignited by a flame of a candle held some distance from the vulva of the pregnant animal. The cow did not appear to suffer from the accident.

Indications.—Deep incisions must be practised on the surface of the body of the fœtus as far as the hand can reach. The maternal passages, as well as the fœtus, must then be lubricated with linseed-tea, oil, or lard; and if the position is normal, traction may be tried.

Should mechanical means fail, then embryotomy must be practised. After this the uterus must be thoroughly irrigated with a mild antiseptic douche to get rid of the putrefying débris and prevent metritis.

In bitches and sows, hysterectomy is to be preferred to embryotomy.

Bad sequelæ after emphysema are metritis, metroperitonitis, septicæmia, and death.

Polysarcia, described only by German authors, consists of abnormal accumulation of fat in the subcutaneous connective tissue. Sometimes calves affected in this way weigh more than a hundredweight (lard calves). The diagnosis and treatment are as for excessive volume of the fœtus.

Contractions.

Muscles, even tendons and ligaments, of the fœtus are sometimes permanently contracted or retracted during intra-uterine life. The muscles of the neck and fore-limbs are chiefly affected, and these parts of the body are given a vicious direction, which often becomes a troublesome cause of dystokia.

The causes of these deviations are very obscure. Bouley was of opinion that they were due to the accommodation of the muscles or ligaments to some false position assumed for a long time by the fœtus. Rainard thought that they

were due to pressure exerted by the colon of the mother when filled with hard fæcal matter, or that they were owing to disease of nerve centres. Contractions of the flexor tendons is observed in many of the progeny of certain sires.

When the neck is affected (wry-neck in the foal), it is bent round to the side, the nose being buried in the flank, or even resting on the hind-quarters of the fœtus; and so rigidly is it curved, that not only does it resist attempts to straighten it

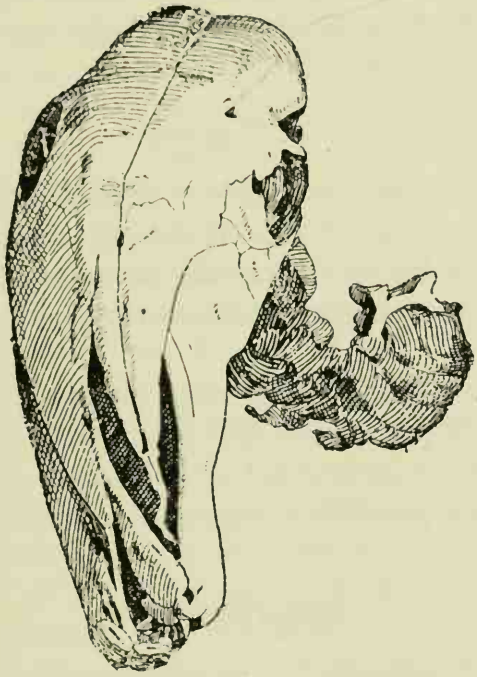

FIG. 81. — DEFORMED HEAD AND NECK OF A FOAL DUE TO CONTRACTION AND PRESSURE IN THE UTERUS. (FRANCK.)

when in the uterus, but even when extracted it cannot be put straight.

The period at which this deviation occurs is, of course, difficult to estimate. Probably it takes place early because of the deformity of the bones of the head and neck, which results in many cases. This distortion is more frequent in solipeds, the neck of which is longer than that of ruminants or other domestic animals. According to French writers, it appears to be more common in some localities, and particularly in years of scarcity or bad forage.

Contraction of the limbs also appears to be more frequent in foals than calves, and varies in degree: from slight bending

at the knees—which disappears shortly after birth—to extreme flexion.

Indications.—The indications for delivery are the same as those which will be given for extraction of the fœtus in malposition of the limbs and head.

Not infrequently recourse must be had to embryotomy. In flexion of the limbs, a careful examination must be made to find whether the joints are movable before traction is employed, or rupture or laceration of the uterus may result. In some extreme cases, tenotomy may be required to bring about extension of the limbs.

Tumours.

Tumours of various kinds, situated either externally or internally, are rare. Some of the former are cysts, which in some instances are of the nature of teratomata. Hygromata are not very uncommon. Sometimes the tumours are fibro-fatty.

Indications.—When the tumour forms an obstacle to birth, then it must be punctured, if it contains fluid, to let the latter escape, or it must be excised if it is solid and accessible. If the latter is not possible, then embryotomy must be practised.

MONSTROSITIES.

The term "monster," "monstrosity," or *lusus naturæ*, is applied to a creature which presents some serious anomaly or organic deviation in form or structure, or both, in one or more parts of the body.

It was only towards the beginning of last century that these anomalies were shown to be only simple modifications or irregularities in the development of organs.

Origin of Monstrosities.

In ancient times the appearance of monstrosities was ascribed to the influence of enraged gods, and they were regarded with fear and horror; or they were looked upon as prodigies or freaks of nature, and described as marvels or curiosities. The opinion which at present prevails with

respect to these malformations is to the effect that the embryo or fœtus has been submitted to some kind of alteration *in utero*, and that this has been produced during the interval between conception and birth. It is a matter of ordinary observation that sometimes a fall, blow, or sudden fright, will in woman disturb the ordinary course of pregnancy, and give rise to more or less unusual symptoms, and even premature birth of an imperfect fœtus.

It is a common belief that a powerful mental impression may have a similar effect, but it is most probable that the cases noted are mere coincidences. Many of the monstrosities are accompanied by no history of an accident to account for their formation. At the same time, the most probable and prominent factors in their production are considered to be irregularity or inequality in the nutrition of the fœtus, physical injury, undue pressure, alterations in or attachments of the membranes, or diseased conditions of the young creature. Perhaps to the pressure to which the fœtus in ruminants is exposed, owing to the accumulation and fermentation of the food in the rumen, must be attributed the greater frequency of anomalies in this species than in any of the other domesticated animals. In-and-in breeding and heredity may also have some influence in this direction.

The formation of monstrosities is more particularly due to retardation or arrested development. The deviation is the effect of disturbance and arrested supply of nutriment during the period of intra-uterine growth. Meckel and others have shown the striking analogy there exists between many anomalies and various transitory conditions of embryonic organization. Saint-Hilaire has proved experimentally, by means of eggs artificially hatched, that the production of monstrosities is due to the interruption or accidental suspension of development which had commenced in a regular manner. Thus, in spina bifida (complete) the medullary groove of the embryonal area is still present, and the neural ring of the vertebra is not completed over it. The superficial layer of nerve matter is continuous with the skin. Hare-lip results from defective closure of the facial clefts. Cyclops formation may be attributed to arrested growth of the anterior extremity of the body when the mother-cells have been given off.

Occasionally accessory centres of growth are formed, as in cases where polydactylism results. This may be effected by the accidental splitting up of the normal growth centres.

For the formation of double monstrosities two theories are put forward. According to one, there have been originally two ova, which may have been derived from one or from two Graafian follicles rupturing at or near the same time, becoming fused by pressure in their passage. The other theory supposes the existence of only one ovum, by whose division the double monstrosity is formed.

The latter theory is the one which is gaining acceptance It is backed up by experimental evidence. It has been shown that if the blastomeres of the egg of the sea-urchin, or frog, or Amphioxus, are imperfectly separated, double monsters result. It may be that in many of the cases cleavage occurs, not in the ovum itself, but in the germinal area—*i.e.*, two primitive streaks form upon a single embryonal area. The deduplication may even take place later in the development from the single primitive streak at one or both ends. The two halves are separated, and the separated extremities have the power of producing the wanting lateral half of each. There may even be a further stage of this process, and a subdivision of the lateral halves. That such an explanation is reasonable would appear from examination of double monsters. When two animals are united, it is usually at similar points and by similar organs, and these animals are frequently of the same sex and present great similarities. In monochorial twins, where one twin is more vigorous, it usurps more and more of the placental circulation, until, through anastomosis, it drives its blood into the umbilical artery of the other twin. In such a case the heart of the second twin fails to develop (fœtus acardiacus), and it may even remain as an amorphous lump of flesh (fœtus amorphus). The smaller fœtus sometimes becomes included in the larger.

The two classifications given below are those of Gurlt and Isidore Geoffroy Saint-Hilaire.

Gurlt arranges monstrosities in two classes:

1. *Simple*, which comprises eight orders, twenty-six genera, and seventy-three species.

2. *Compound*, which includes six orders, twenty-six genera, and fifty-nine species.

CLASS I.

Simple Monstrosities.

This class deals with single individuals in which there is an absence of or addition to parts, exaggeration of them, or alteration in their form or position.

Order I.: Simple Monstrosities through Absence of Parts

1. Amorphus.—Absence of conformation ; one species : *A. globosus.*

2. Acephalus.—Headless ; two species : *A. unipes*, *A. bipes.*

3. Perocephalus.—Head defective ; seven species : *P. pseudocephalus* (apparently without a head), *P. aprosopus* (head without a face), *P. microcephalus* (small head), *P. agnathus* (head without a jaw). Varieties : (*a*) *P. agnathus hypostomus* (mouth a longitudinal fissure beneath the ordinary situation) ; (*b*) *P. agnathus microstomus* (small mouth) ; (*c*) *P. agnathus astomus* (without a mouth), *P. brachyrhynchus* (short face or nose), *P. anomatus* (without eyes), *P. aotus* (without ears).

4. Perosomus.—The whole of the body defective ; four species . *P. hemicephalicus* (body defective and head absent), *P. horridus* (horrid deformity), *P. elumbis* (loins absent), *P. pseudoscelus* (body defective, with posterior limbs incomplete).

5. Perocormus.—Trunk defective ; three species : *P. oligospondylus* (defective vertebræ), *P. ecaudatus* (without tail), *P. anacdoca* (without external generative organs).

6. Peromelus.—Limbs defective ; six species ; *P. apus* (without limbs), *P. achirus* (without anterior limbs), *P. monochirus* (with only one anterior limb), *P. ascelus* (without posterior limbs), *P. monocelus* (with only one posterior limb), *P. micromelus* (limbs shortened) ; with the varieties : *P. micromelus microchirus* (anterior limb short), *P. micromelus microscelus* (posterior limb short).

Order II.: Simple Monstrosities through Smallness of Parts.

7. Nanosomus. — Limbs and trunk small — dwarf; two species: *N. pygmæus* (short and low, but without disproportion of parts), *N. caticeps* (cat-faced dwarf).

8. Nanocephalus.—Small head; three species: *N. micromatus* (eyes too small), *N. brachyotus* (ears too short), *N. brachygnotus* (lower jaw too short).

9. Nanocornus. — Short trunk; two species: *N. rectus* (vertebral column straight, but very short), *N. curvatus* vertebral column short, and curved to one side).

10. Nanomelus.—Limbs short; five species: *N. brevipes* (all the limbs short), *N. brachychirus* (anterior limbs too short), *N. campylochirus* (anterior limbs short and crooked), *N. chiropterus* (anterior limbs short, with cutaneous folds resembling wings), *N. compyloscelus* (posterior limbs short and crooked).

Order III.: Simple Monstrosities through Abnormal Division of the Body.

11. Schistocephalus.—Division of the head; five species: *S. hemicephalus* (cleft in the middle); with the varieties: (*a*) *S. hemicephalus partialis*, or *hydrencephalocele* (partial hernia of the brain, with hydrocephalus); (*b*) *S. hemicephalus totalis* (absence of all the cranium); (*c*) *S. hemicephalus complicatus* (cleft cranium, face defective); *S. bifidus* (face divided), *S. fissipalatinus* or *rictus lupinus* (cleft palate), *S. fissilabrus* or *labium leporinum* (cleft or hare lip), *S. megalostomus* (wide mouth).

12. Schistocormus.—Divided trunk; six species: *S. fissicollis* (neck cleft), *S. fissisternalis* (sternum divided), *S. schistepigastrico-sternalis* (division of the sternum and anterior portion of the abdomen), *S. exomphalus* (divided umbilicus), *S. fissiventralis* (the whole of the abdomen divided), *S. fissispinalis* or *spina bifida* (division of the spinal column)

13. Schistosomus.—Division of the head and trunk; three species: *S. reflexus* (division of the body and inversion of the spinal column), *S. contortus* (division of the body and torsion

of the vertebral column), *S. microchirus* (division of the body and anterior limbs shortened).

14. Schistomelus.—Cleft limbs; two species: *S. fissimanus* (division of the anterior limbs), *S. fissungulus* (division of the phalanges).

Order IV.: Simple Monstrosities through Absence of the Natural Division of Parts.

15. Atretocephalus.—Absence of openings in the head one species: *A. astomus* (mouth absent).

16. Atretocormus.—Absence of the natural apertures in the body; two species: *A. aproctus* (anus absent), *A. anurethra* (urethra absent).

17. Aschistodactylus.—Phalanges undivided; one species: *A. solidungulus* (absence of division of the phalanges and claws in those animals which usually have them divided).

Order V.: Simple Monstrosities through Fusion or Coalition of Organs.

18. Cyclops or Monophthalmus.—One eye in the middle of the face, and a proboscis in addition; three species: *C. megalostomus* (large mouth), of which there are two varieties—(*a*) *C. megalostomus rhynchænus* (large mouth and proboscis); (*b*) *C. megalostomus arhynchus* (large mouth, but no proboscis); *C. prostomus* (irregular mouth), in which are two varieties — (*a*) *C. prostomus arhynchus* (irregular mouth and no nose); (*b*) *C. prostomus rhynchænus* (irregular mouth and nose); *C. astomus* (without mouth), with two varieties—(*a*) *C. astomus arhynchus* (mouth and nose absent); (*b*) *C. astomus rhynchænus* (proboscis present, but mouth absent).

Order VI.: Simple Monstrosities through Abnormal Position and Form of Parts.

19. Campylorrhinus.—Curvature of the nose; one species: *C. lateralis* (lateral curvature of the nose).

20. Camylorrhacchis.—Curvature of the vertebral column; two species: *C. scoliosa* (lateral curvature of the spine), *C. contorta* (torsion of the spine).

Order VII.: Simple Monstrosities through Excess in Formation.

21. Megalocephalus.—Head abnormally large; two species: *M. hydrencephalus* (with hydrocephalus), *M. polycerus* (head with large horns).

22. Diphallus.—Double penis; one species: *D. imperfectus* (double penis, incomplete).

23. Megalomelus.—Limbs with supernumerary parts; one species: *M. perissodactylus* (with supernumerary digits).

Order VIII.: Hermaphrodites.

24. Hermaphroditus.—Double sex, with predominance of organs belonging to one sex; two species: *H. lateralis* (genital organs to one side), in which there are two varieties—(*a*) *H. lateralis masculinus* (with predominance of the male organs); (*b*) *H. lateralis femininus* (with predominance of the female organs); *H. transversalis* (the external generative organs belonging to one sex, and the internal to the opposite sex), including two varieties—(*a*) *H. transversalis masculinus* (external genital organs male, internal female); (*b*) *H. transversalis femininus* (external genital organs feminine, internal male—often imperfect).

25. Pseudo-Hermaphroditus.—False hermaphrodites; four species: *P. megalomasthus* (male with large mammæ), *P. microphallus* (penis unusually small), *P. hypospadiatus* (with the urethra divided inferiorly), *P. femininus* (false feminine hermaphrodite).

26. Androgynus.—Double hermaphrodites, the male and female organs existing in a single individual, one sex being incomplete and the other predominating; two species: *A. masculinus* (the external organs are masculine, with a small penis, the internal organs being male and female—though the one set is more complete than the other), *A. femininus* (the external organs are feminine, with abnormally large clitoris, the internal being male and female, with predominance of the one over the other).

CLASS II.

Treble and Double Monstrosities.

In these monstrosities there is a union of two or three individuals, neither of which is complete, but which are united at various points; often with a completely-developed body is united a portion of a second individual.

ORDER I.: TRIGEMINAL MONSTROSITIES, IN WHICH ARE UNITED ONE OR MORE PARTS OR ORGANS OF THREE INDIVIDUALS.

1. CEPHALOTRIDYMUS.—Three heads united to a single trunk; one species: *C. unicorporeus* (with a single body).

2. CORMOTRIDYMUS.—Posterior part of the trunk triplicate, with more than four limbs; one species: *C. tricaudatus* (three croups with three tails, but only one anus and four posterior limbs).

3. MELOTRIDYMUS.—Posterior part of the body double, and more than eight limbs; one species: *M. decapus* (ten limbs of unequal length).

4. SOMATOTRIDYMUS.—Triple body; one species: *S. sternalis* (three chests united).

ORDER II.: MONSTERS WITH TWO HEADS (CEPHALODIDYMI).

5. DIPROSOPUS.—Double face; three species: *D. sejunctus* (the two faces separate), *D. distans* (the two faces diverging), including three varieties—(*a*) *D. distans distomus* (a mouth in each face); (*b*) *D. distans monostomus* (a mouth in one face only); (*c*) *D. distoma hemicephalicus* (without a cranium); *D. conjunctus* (two faces united), has two varieties—(*a*) *D. conjunctus distomus* (double mouths); (*b*) *D. conjunctus monostomus* (with one mouth).

6. MONOCRANUS.—Single cranium; four species: *M. mesognatus* (the lower jaw included in or united to the other from the commencement of the branches), *M. dignatus* (lower jaw double), *M. heteroprosopus* (diverse faces), *M. bimandibularis* (upper jaw double).

7. HETEROCEPHALUS.—Double heads, one of which is complete, the other very incomplete; two species: *H. interpositus* (between the two branches of the lower jaw of the complete

head is interposed the lower jaw of the incomplete one), *H. oppositus* (the lower jaw of the complete head is depressed in front, and on its upper surface—anterior extremity—it is united to the corresponding part of the second jaw, with which it forms an acute angle).

ORDER III.: DOUBLE-HEADED MONSTROSITIES, WITH THE TRUNK WHOLLY OR PARTIALLY DOUBLE.

8. DICEPHALUS.—Two separate heads; seven species: *D. biatlanticus* (double head and two atlases), *D. subbicollis* (double head with apparently two necks), *D. bicollis* (double head and two necks), with two varieties—*D. bicollis omocephalus* (both heads alike), *D. bicollis heterocephalus* (one head perfect, the other imperfect); *D. subbidorsualis* (double head, with apparently a double back), *D. bidorsualis* (double head with double back), *D. bilumbis* (double head and double loins), *D. bispinalis* (double head and vertebral column), has two varieties—(*a*) *D. bispinalis quadrupes* (with four limbs); (*b*) *D. bispinalis achirus* (without anterior limbs).

9. DICRANUS.—Double cranium; one species: *D. bispinalis* (cranium and vertebral column double).

ORDER IV.: MONSTROSITIES WITH A SINGLE HEAD, BUT THE TRUNK OR LIMBS MORE OR LESS COMPLETELY DOUBLE (CORMO-DELODIDYMI).

10. DIPYGUS.—Double croups; three species: *D. bidorsualis* (double croup and back), *D. subbidorsualis* (double croup, with half the back doubled), *D. bilumbis* (croup and loins doubled), containing two varieties—(*a*) *D. bilumbis teleocephalus* (with head regular); (*b*) *D. bilumbis cacocephalus* (with head irregular).

11. HETERODIDYMUS.—Unequally-developed twins, the body of one being large and regularly or irregularly formed, the other being small and slenderly attached to some part of its fellow; three species: *H. octipes* (with eight feet), containing two varieties—(*a*) *H. octipes emprosthochirophorus* (the anterior limbs of the parasitic twin situated in front); (*b*) *H. octipes pleurochirophorus* (the anterior limbs of the parasitic twin situated at the side); *H. tetrasulus* (with four posterior extremities), also containing two varieties—(*a*) *H. tetrasulus*

monopygus (with one croup); (*b*) *H. tetrasulus dipygus* (with a double croup); *H. triscelus* (with three posterior limbs).

ORDER V.: MONSTROSITIES WITH A SINGLE HEAD AND TRUNK, AND MORE THAN FOUR LIMBS (MELODIDYMI).

12. OPISTHOMELOPHORUS.—An animal regularly formed, but which bears on its back or croup a supernumerary limb or limbs; three species: *O. trichirus* (with an anterior limb on the back), *O. tetrachirus* (with two anterior limbs on the back), *O. tetrascelus* (with two posterior limbs on the croup).

13. EMPROSTHOMELOPHORUS.—With a supernumerary limb or limbs on the neck, thorax, or beneath the pelvis; five species: *E. octipes* (with four supernumerary limbs beneath the thorax), *E. trichirus* (with an anterior limb on the thorax), *E. tetrachirus* (with two anterior limbs on the neck), *E. triscelus* (with a posterior limb beneath the pelvis), *E. tetrascelus* (with two posterior limbs beneath the pelvis).

14. PLEUROMELOPHORUS.—With a supernumerary limb or limbs situated on the side; four species: *P. octipes* (with four limbs on the side), *P. tetrachirus* (with two anterior limbs on the side), *P. trichirus* (with an anterior supernumerary limb), *P. triscelus* (with a posterior supernumerary limb).

ORDER VI.: MONSTROSITIES WITH THE HEAD, TRUNK, AND LIMBS, MORE OR LESS COMPLETELY DOUBLE (SOMATODIDYMI).

15. OCTOPUS.—With eight limbs; four species: *O. janus* (two faces placed opposite each other, and eight limbs), *O. quadriauritus* (eight limbs and four ears), containing two varieties—(*a*) *O. quadriauritus monoprosopus* (with a perfect face); (*b*) *O. quadriauritus aprosopus* (face absent); *O. biauritus* (eight limbs and two ears), *O. synapheocephalus* (eight limbs, and the heads joined externally only by the skin).

16. TETRACHIRUS.—With four anterior limbs; two species: *T. symphocephalus* (four anterior limbs, two lateral and two incomplete, on the back, and heads joined), *T. choristocephalus* (four anterior limbs, and heads separate).

17. TETRASCULUS.—With four posterior limbs; two species: *T. symphocephalus* (four posterior limbs, and heads united) *T. bifacialis* (four posterior limbs, and the two faces separate).

18. Gastrodidymus.—Twins united at the abdomen; three species: *G. quadrupes* (twins united at the abdomen, and furnished with four limbs), *G. tetrachirus* (with four anterior limbs), *G. octipes* (with eight limbs).

19. Gastro-Thoracodidymus.—Twins united at the thorax and abdomen; one species: *G. thoracodidymus octipes* (with eight limbs).

20. Epigastrodidymus.—Twins united at the thorax and epigastrium; one species: *G. octipes* (with eight limbs).

21. Thoracodidymus.—Twins united at the thorax; one species: *T. octipes* (with eight limbs).

22. Schelodidymus.—Twins united at the posterior extremities; one species: *S. heptamelus* (with seven limbs, the posterior pair being united into one, the next pair at the side, and the other four in front).

23. Ischiodidymus.—Twins united at the pelvis; one species: *I. examelus* (with six limbs, four anterior and two posterior).

24. Omphalo-Chronodidymus.—Twins united at the umbilicus and the head; one species: *O. disomatas* (the bodies separate).

25. Pygodidymus.—Twins united at the croup; one species: *P. aversus* (bodies united at the ischia and sometimes at the buttock, and in opposite directions).

26. Cryptodidymus.—Inclusion of one twin within the other; two species: *C. abdominalis* (twin included in the abdomen), *C. subcutaneus* (incomplete fœtus included beneath the skin of the complete one).

Saint-Hilaire divides the monstrosities which exhibit serious anomalies because of the injurious influence they exercise on the function of the individual, or the vicious conformation they give rise to, into two classes—simple and composite.

I. **Simple Monstrosities** are single individuals, and comprise three orders:

1. *Autositic Monstrosities*, whose organs are capable of maintaining them for a variable period after birth.

(*a*) *Ectromelians*, having more or less complete deficiency in the development of the limbs.

(*b*) *Symelian monstrosities*, included in the first class and order of Gurlt.

(*c*) *Celosomian monstrosities*, more frequent, perhaps, than any others, and identical with Schistocormus of Gurlt.

2. *Omphalositic Monstrosities*, which are maintained by the nourishment derived from the mother through the umbilical cord, and die as soon as the cord is ruptured.

(*a*) *Exencephalian monstrosities*, belonging to Gurlt's third order in the first class, are those which have the brain defective, deformed, and external to the cranial cavity, itself more or less imperfect.

(*b*) *Pseudencephalian monstrosities* belong also to the third order of Gurlt's first class, the brain being absent and replaced by a bright red tumour, composed of bloodvessels resting on the base of the cranium, the roof of which is absent.

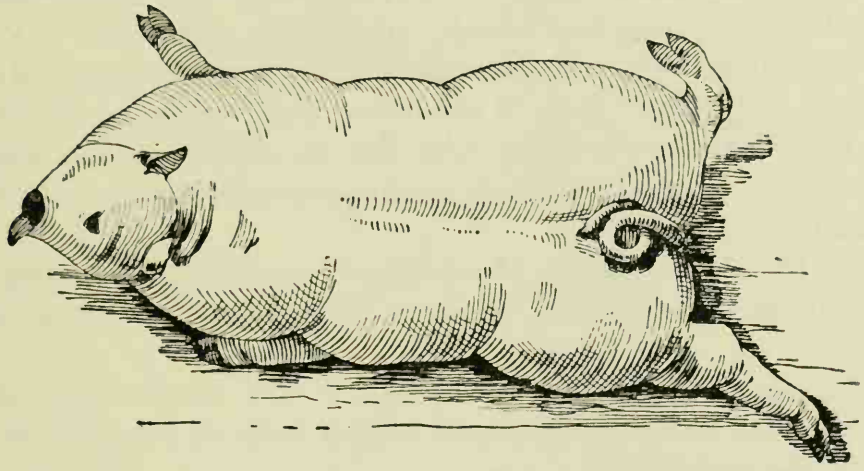

FIG. 82.—SYMELIAN MONSTROSITY (SAINT-HILAIRE); PEROSOMUS PSEUDOSCELUS (GURLT): PIG. (RUEFF AND BAUMEISTER.)

(*c*) *Anencephalian monstrosities*—Gurlt's first order, first class—are destitute of brain and the roof of the cranium.

(*d*) *Cyclocephalian monstrosities* are identical with Class I., Order V. of Gurlt.

(*e*) *Acephalian monstrosities*—Gurlt's first class and first order—are more or less destitute of head, sometimes of neck, thorax, and thoracic organs.

3. *Parasitic Monstrosities*, the most imperfect of all, destitute of umbilical cord, and attached to the generative apparatus of the mother.

The *anidian monstrosities*, which have already been described at p. 122, belong to this order.

II. **Composite Monstrosities** result from the union of two or

three individuals equally or unequally developed. They include the following:

1. *Autositarian Monstrosities*, composed of two individuals more or less intimately united, and somewhat equal in their development.

(*a*) *Eusomphalian monstrosity* has an umbilical cord for each fœtus.

(*b*) *Monomphalian monstrosity* has only one umbilicus and one cord; the fœtuses are joined at the ventral surface, and have usually several organs in common, notably the liver.

(*c*) *Syncephalian monstrosity* has the two heads fused while the bodies are more or less separate.

(*d*) *Monocephalian monstrosity* has only one head, but a double body, separated usually behind the umbilicus.

(*e*) *Sysomian monstrosity* has two heads on apparently a single body, some parts of the latter, however, being double.

(*f*) *Monosomian monstrosity* has in reality only a single body, the duplicity only generally commencing towards the neck.

2. *Double Parasitic Monstrosities* consist of two unequal individuals, the smaller living on and at the expense of the larger.

(*a*) *Heterotypians* are of this nature, and the smaller fœtus is attached to the anterior part of the body of the other at or near the umbilicus.

(*b*) *Heteralians:* In this variety the parasitic fœtus is very incomplete, as a head without a body, and is attached some distance from the umbilicus.

(*c*) *Polygnathians:* In this variety the parasite is reduced to the mere fragments of a fœtus, the jaws and some cephalic remains adhering to the jaws of the other fœtus.

(*d*) *Polymelians* comprise those creatures in which there is only a single body and head, but supernumerary limbs. Occasionally there are in addition some other organs, such as heart and lungs. The "Nadeah" bullock of India is probably of this type.

(*e*) *Endocymian monstrosities* are those double fœtuses of which one or part of one is included within the other.

Other classifications are given by Taruffi, Ballantyne, Adami, etc.

Frequency of Monstrosities.

Monstrosities are far from being rare in the domesticated animals, and among them are found most frequently in bovines.

Gurlt gives the following list of 740 monstrosities, showing the proportion in each species: Cow 239, ewe 179, sow 87, bitch 78, cat 71, mare 56, goat 24, mule 3, ass 3. Saint-Cyr in 71 instances found 45 calves, 16 lambs and kids, 4 pigs, 4 kittens, 1 puppy, 1 foal. Baumeister and Rueff mention that in the King of Würtemberg's private stud, of 2,340 foals produced, there were only nine monstrosities. In

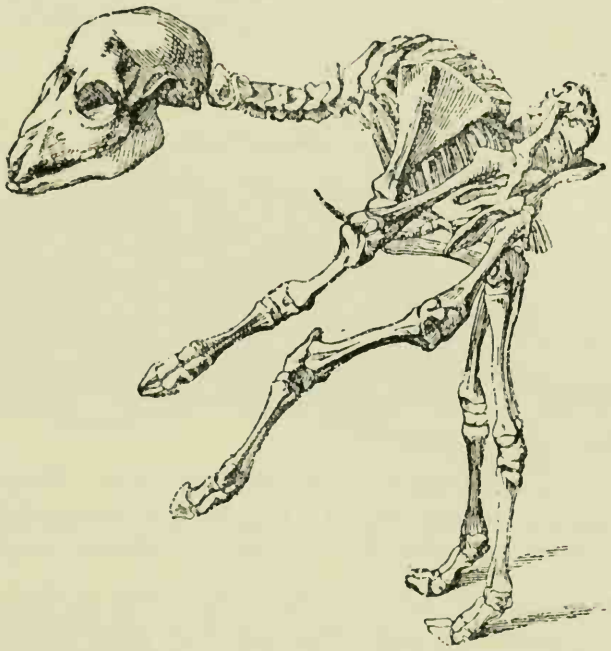

FIG. 83.—CAMYLORRHACCHIS CONTORTA. (RUEFF AND BAUMEISTER.)

the Hohenheim dairies, among the cows the monstrosities were only one-half per cent., and among sheep one in 768 lambs.

Though monstrosities are not rare in animals, yet all do not give rise to difficult parturition: for in some instances the deformity does not interfere at all with birth; in others, in which the deformity is of such a nature as would impede delivery, birth often occurs prematurely when the fœtus or fœtuses are small and soft; while even when fully developed, double and triple monstrosities have occasionally been born without assistance.

Nevertheless many monstrosities give rise to dystokia, and the most common of these will now be referred to.

Distorted Monstrosities (Camylorrhacchis Contorta).—This is a monstrosity in which the vertebral column is twisted and the body doubled upon itself. It may be due to muscular contraction of the fœtus or to extraneous uterine pressure. It is occasionally noted in the cow.

If the presentation is anterior, the obstetrist may find the head and fore-limbs in the passage, but will also discover two hind-limbs alongside the others, with their plantar aspect turning upwards. It is not always easy to distinguish this condition from twins. With twins, one can repel one fœtus

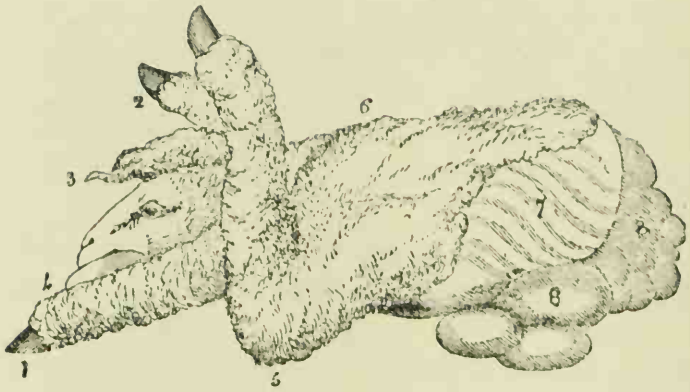

Fig. 84.—Celosomian Monstrosity: Lamb. (Youatt.)
1, Hind-foot; 2, fore-feet; 3, tail; 4, tongue; 5, elbow of left fore-limb; 6, stifle; 7, ribs everted; 8, viscera.

and draw the other into the passage; but in this case, if one extremity is repelled, the other portion goes with it.

The chief remedy here is *embryotomy*.

Williams recommends that the two fore-limbs be removed, the fœtus eviscerated, the neck and thorax repelled after the hind-limbs are secured, and the presentation converted into a posterior one. Then traction may be used to extract the fœtus.

As a last resort Cæsarian section may be attempted.

Celosomian Monstrosities (Schistosomus Reflexus or Contortus).—These monstrosities are more or less destitute of abdominal and thoracic parietes, and otherwise deformed in various degrees. They also are found most frequently in the cow, occasionally in the sheep and goat. Of seventy-one mon-

strosities referred to by Saint-Cyr, twenty-three belonged to this order, and of these twenty-one were calves, only one kid and one lamb. In these anomalies the viscera are exposed, and the four legs and head and neck are placed close together, frequently in a reduplicature of skin. The explanation of the production of this monster is as follows: The embryo is at first a small thickened area on the surface of the ovum. The edges of this area curve in to join and close the body cavity. Failure to do this causes the exposure of the contained organs.

The *Diagnosis* depends upon the discovery of the peculiarity of the fœtus by vaginal examination. In thirty-two instances noted, twenty-eight of the fœtuses presented by the abdomen. Then the fœtal intestines are found at the genital

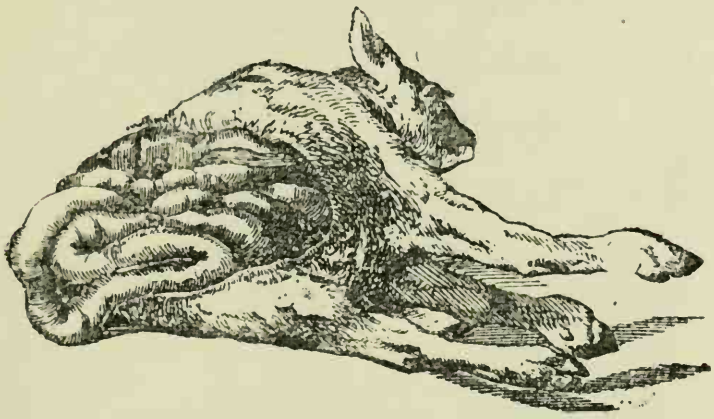

Fig. 85.—Celosomian Monstrosity (Saint-Hilaire); Schistocormus Fissiventralis (Gurlt): Calf. (Rueff and Baumeister.)

orifice of the mother, and in front of them, in the uterus, an exposed vertebral column and bent ribs.

When the presentation is anterior, the hand will first meet the head, and around it all the feet, but cannot separate these and push back the posterior limbs, in order to put the fœtus in a good position, because of the rigidity of the crooked spine. In some cases the heart is exposed, and if the fœtus is alive the contractions of this organ may be felt.

Prognosis.—When parturition is difficult the case is rather serious. In twenty-eight abdominal presentations, twenty-three births occurred without permanent injury to the mother, some without assistance. The other five were killed. In four anterior presentations four cows died.

Extraction.—Embryotomy is usually necessary unless the fœtus is small and the pelvis very roomy.

The fœtal viscera must first be removed in a posterior presentation. Then, if necessary, the vertebræ and ribs must be taken away before delivery by traction with ropes or hooks

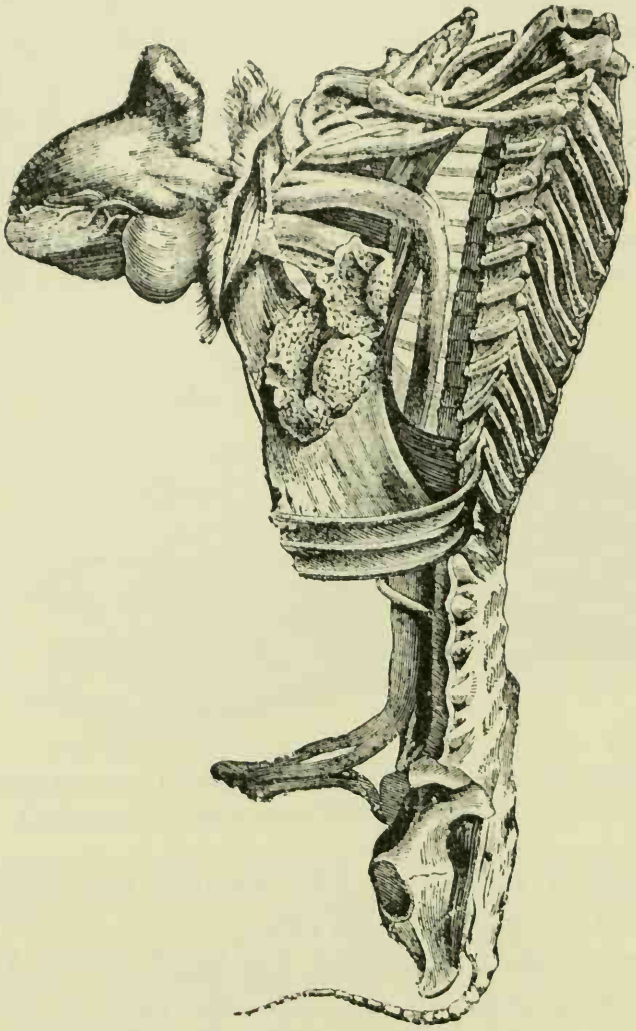

FIG. 86.—ECTOPIA CORDIS: SCHISTOCORMUS FISSISTERNALIS. (HERING.)

can be effected. When the head and all the feet are presented, the case is more serious. In most cases it will be necessary to amputate one or more limbs, according to the rules to be prescribed for the operation. In some cases it may be necessary to excise two, three, or all of the legs, and even the head of the fœtus, before delivery can be completed.

Double-headed (Monosomian and Sysomian) Monstrosities are observed more particularly in ruminants, rarely in the pig and cat. Many of these creatures are born alive, and live for some time after birth, even up to fifty days. The existence of this anomaly renders birth more or less difficult, or even impossible, according to the size of the heads, their point of junction, whether at the face or cranium or towards the neck, and also according as the presentation is anterior or posterior. As a rule the presentation is anterior. In dystokia a vaginal examination will reveal the existence of the condition.

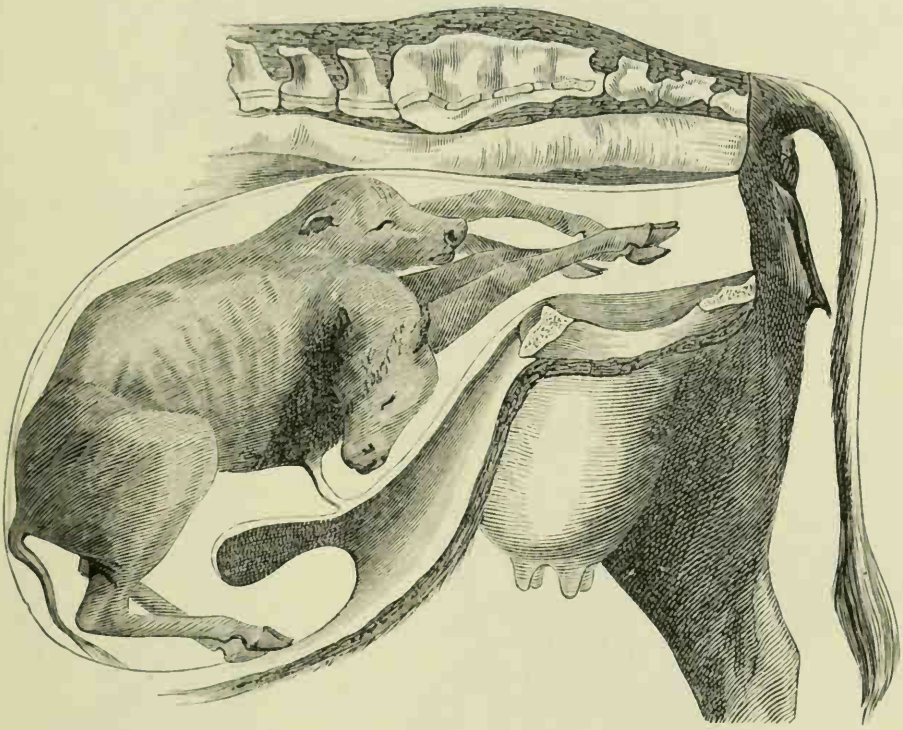

FIG. 87.—SYSOMIAN MONSTROSITY: DICEPHALUS BICOLLIS (GURLT). (SAINT-CYR.)

Treatment.—As a rule embryotomy will have to be resorted to, or even Cæsarian section. Decapitation of one or both heads may sometimes suffice. When the heads are united at the cranium, the obstetrical saw or chisel may be employed to disunite them at their junction. With double necks, amputation of one head and neck should be effected as low down as possible. In some cases judicious manipulation and well-timed traction will effect delivery.

Double Monstrosities consist of two fœtuses joined together. They are found chiefly in the cow, rarely in the sheep and sow, and even more rarely in the mare. They are always distinguished by having the whole or a large portion of the body, thorax, abdomen, or pelvis double, and frequently the limbs increased in number. They usually offer a serious obstacle to delivery. Occasionally birth takes place without difficulty, and the young creatures may live.

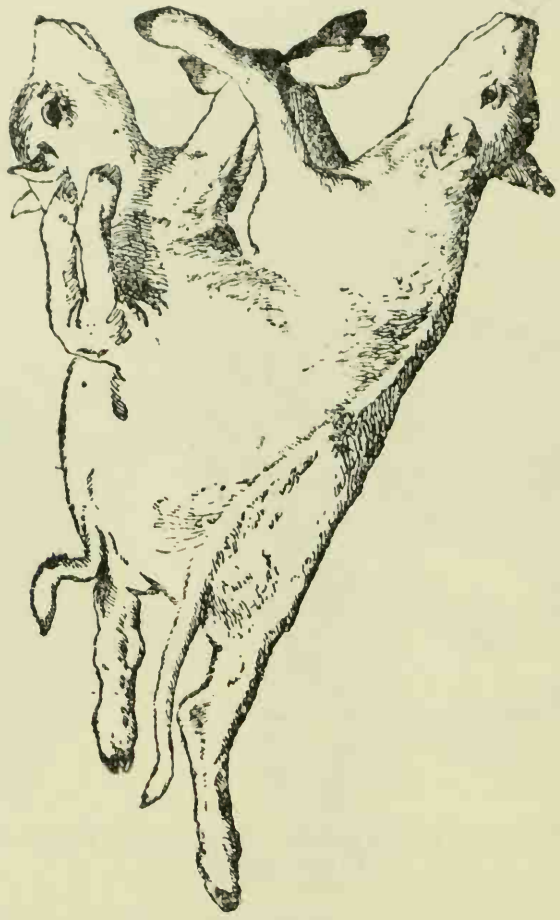

FIG. 88.—MONOMPHALIAN MONSTROSITY: CEPHALO-CORMODIDYMUS (GURLT). (RUEFF AND BAUMEISTER.)

Diagnosis.—Sometimes at an examination of a case of dystokia these monstrosities are mistaken for ordinary twins. Commonly the double extremity is presented. The monstrosity can only be recognized by a careful examination for the line of union of homologous parts between the two fœtuses. Again, if one is repelled, then the other must go

FIG. 89.—MONOSOMIAN MONSTROSITY; DICEPHALUS BI-ATLANTICUS (GURLT) CALF. (ORIGINAL.)

FIG. 90.—MONOCEPHALIAN MONSTROSITY: CORMO-MELODIDYMI (GURLT). (RUEFF AND BAUMEISTER.)

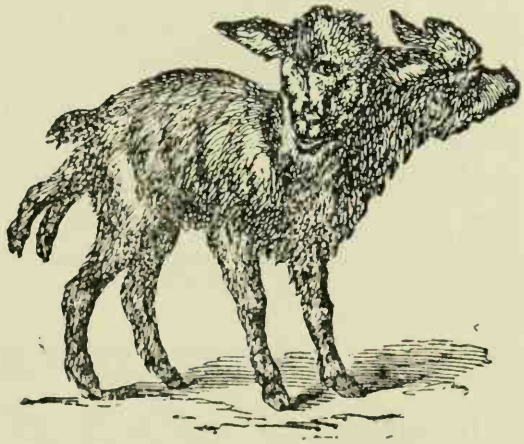

FIG. 91.—SYSOMIAN MONSTROSITY: DICEPHALUS BICOLLIS (GURLT). (RUEFF AND BAUMEISTER.)

with it. Where the single end is presented—*e.g.*, monocephalian monstrosities—the condition will not be recognized

until that extremity passes the vulva, and its further progress is stopped, when the hand is passed forwards between the fœtus and vagina and finds a double pelvis.

Extraction.—In a few cases, where the fœtuses are small, extraction may be possible by manipulation and judicious traction. As a rule embryotomy, or even Cæsarian section, must be practised. If possible, the two fœtuses should be separated by knife and obstetrical saw or bone forceps, but frequently the union is too extensive.

When the monstrosity is in the anterior position, if it is

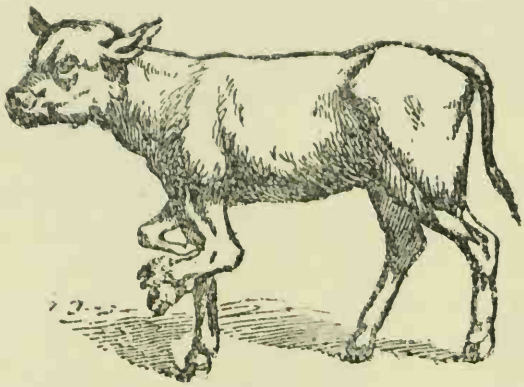

FIG. 92.—POLYMELIAN MONSTROSITY; EMPROSTHROMELOPHORUS (GURLT): CALF. (RUEFF AND BAUMEISTER.)

double-headed, one head and neck should be removed; and, if necessary, in addition one or more fore-limbs. In the case of very large fœtuses, eventration of the thorax and abdomen will be necessary, and even destruction of the pelvic girdle and amputation of the hind-limbs. When the presentation is posterior, the procedure will be in the reverse direction.

DYSTOKIA FROM MULTIPARITY.

In multiparity the twins are usually smaller than in uniparous births. Dystokia from multiparity always happens when the two fœtuses present together at the pelvic inlet. Although individually small, they cannot possibly pass through the canal at the same time. The fœtuses may be so

situated that, when the hand is introduced into the vagina or os, it will encounter the head of one fœtus, with the fore-limbs of the other; or four anterior or posterior limbs; or two hind and two fore limbs; or two, four, or six feet; or a head and a tail, etc. It is not always easy to distinguish between twins and double monstrosities; this can only be done by careful examination and manipulation. If the head of one fœtus is presented with the fore-feet of another, it will require a very careful examination to show that these parts do not belong to the same fœtus. In other instances

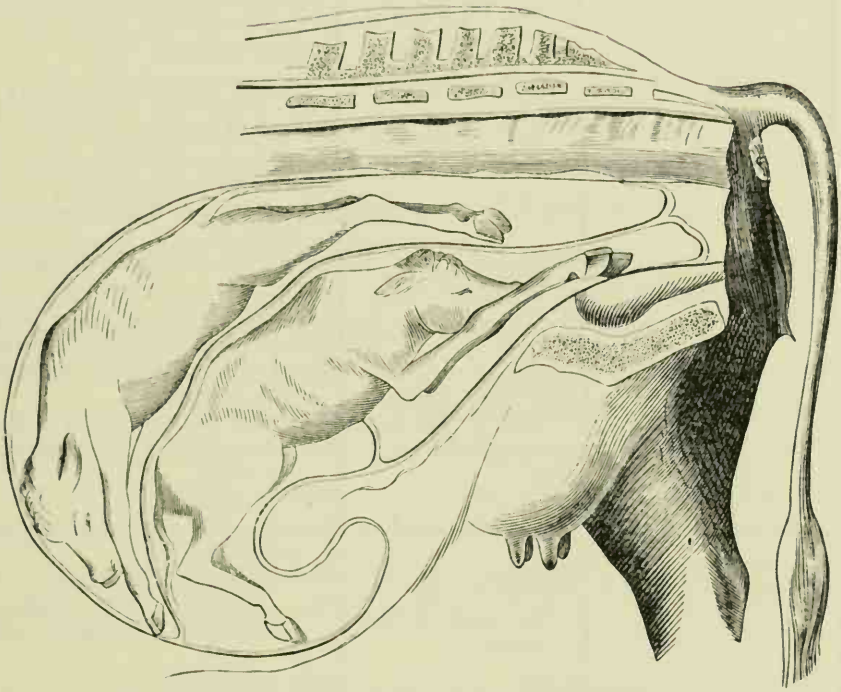

FIG. 93.—TWIN FŒTUSES, IN DIFFERENT PRESENTATIONS, PASSING INTO THE GENITAL CANAL. (SAINT-CYR.)

the limbs of the fœtuses are so interlocked (locked fœtuses) that they are with the greatest difficulty disengaged.

Extraction.—The fœtuses must be disengaged. The one in the most favourable position is fixed with cords, and the other pushed forward well into the uterus. The first fœtus is then drawn into the passage and delivered. The second fœtus is next brought into position, which is corrected, if abnormal, and also extracted.

GROUP II.—DYSTOKIA FROM MALPRESENTATION OR MALPOSITION OF THE FŒTUS.

The following synoptical table shows the various causes of fœtal dystokia dependent on abnormal presentations and positions:

- **Anterior presentation**
  - Natural ... ...
    - Abnormal positions
      - Dorso-pubic.
      - Dorso-supra-cotyloidean (right or left).
    - Obstacles due to the hind-limbs
      - The hind-limbs are extended and retained at the stifles.
      - The hind limbs are flexed beneath the body, and enter the pelvis with it.
  - Causes which may be met with in all positions
    - Obstacles due to the fore-limbs
      - The limbs are on the neck.
      - The limbs are incompletely extended in the pelvis.
      - The limbs are flexed at the knees.
      - The limbs are completely retained.
    - Obstacles due to the head
      - The head is flexed beneath the chest.
      - The head is turned to one side of the body.
      - The head is extended on the back.
      - The head is flexed downwards.
    - Combined obstacles due to the head and limbs
      - The head is retained with one or both fore-limbs.
      - The head is retained, or one of the fore or hind limbs has entered the pelvis.
- **Posterior presentation**
  - Natural ... ...
    - Abnormal positions
      - Lumbo-pubic.
      - Lumbo-supra-cotyloidean (right and left).
    - Obstacles due to the head or fore-limbs
      - The neck is contracted.
      - The fore-limbs are under the chest, and enter the pelvis with it.
  - Causes to be met with in all positions
    - Obstacles due to the hind-limbs
      - The limbs are incompletely extended in the genital canal.
      - The limbs are flexed at the hocks.
      - The limbs are completely retained.
- **Transverse presentation**
  - Dorso-lumbar positions
    - Cephalo-ilial (right and left).
    - Cephalo-saeral.
  - Sterno-abdominal positions
    - Cephalo-ilial (right and left).
    - Cephalo-sacral.

DYSTOKIA DEPENDING ON THE ANTERIOR PRESENTATION.

A. Natural Anterior Presentation.

In this presentation the extended head and the outstretched fore-limbs are towards the genital canal.

SECTION I.—DYSTOKIA FROM ABNORMAL POSITIONS.

Dorso-Pubic Position.

On vaginal exploration, the hand detects the position by the fore-feet being directed upwards, and the eyes and ears of the head downwards. The fœtus thus lies on its back, and its shape does not lend itself readily to enter the pelvis. The body of the fœtus is curved slightly on itself, being convex along its dorsal aspect. It has therefore a tendency to jam against the upper surface of the pelvis, and the feet to penetrate the soft tissues there.

To rectify the position, rotation of the fœtus must be practised. The lower jaw and fore-feet should be corded, the head pushed away from the pelvic inlet, and the body turned to the dorso-sacral position with the hand. The head and feet are then brought into the pelvis, and delivery assisted by traction on the cords. In the mare, when the fœtus is small, delivery may be accomplished without rotation in some cases, by guiding the limbs through the genital canal so as to prevent injury to its walls.

Dorso-supra-Cotyloidean Positions.

In these positions the fœtus lies on its right or left side; it must be altered to the dorso-sacral position before birth can be completed. The change is effected in the same manner as in the preceding position.

SECTION II.—DYSTOKIA DUE TO THE HIND-LIMBS.

In the following two conditions the anterior part of the body of the fœtus presents in a normal manner, and nearly always in the dorso-sacral position. Birth appears to be

progressing favourably, the fore-limbs, head, neck, and even the trunk as far as the flanks, may have cleared the vulva and when the act is almost completed, all at once there is a check, and no more of the fœtus can be expelled.

The Extended Hind-Limbs are retained by their Stifles.

This condition may be made out by exploring the vagina. The pelvis of the fœtus appears to be locked with the maternal pelvis. It occurs when the hind-limbs are extended, and the stifles so voluminous as to check progress. It is seen in the cow, and but rarely in the mare. The obstacle is a serious one to overcome, and it not infrequently happens that the young creature is lost, sometimes the mother also.

Indications.—When both stifles are together, they form too large a mass to pass through the genital canal, and must therefore be brought into the inlet separately, one after the other. With this object in view, Saint-Cyr recommends very oblique traction on the fœtus, to the right or left side, so as to force one stifle more into the canal than the other. In many cases, where the fœtus is wedged in the pelvis, it requires to be pushed forward into the abdomen before this oblique traction may be used with success.

In severe cases one must employ embryotomy (for which see p. 423).

The Hind-Limbs, flexed under the Body, pass with it into the Genital Canal (Dog-sitting Position).

This malpresentation is not very common, has been seen in the mare and cow, and is one of the most formidable which can be encountered. The hind-limbs of the fœtus advance into the pelvic canal with the head and fore-limbs, the body being bent at the loins. To do this, the hind-limbs must be closely applied to the abdomen as the chest is entering the inlet.

Nothing is noticed wrong until parturition is advanced. Progressive expulsion may continue until the head of the young animal is beyond the inlet, and even external to the vulva. The further progress is then checked, and even violent traction will not move the fœtus.

In ascertaining the cause of the obstruction, the obstetrist introduces his hand into the vagina along the side of the body of the fœtus (this with considerable trouble), and encounters one or both hind-feet in the pelvis, close to the fœtus, occasionally only in front of the pubis, and finds the back of the fœtus jammed up against the maternal sacrum. The young animal, unless exceptionally small, cannot be extracted in this position. Traction will probably kill the mother as well as the fœtus. Sometimes the severe straining causes the hind-limbs to penetrate the floor of the uterus, especially if the hind-feet lie in front of the pubis.

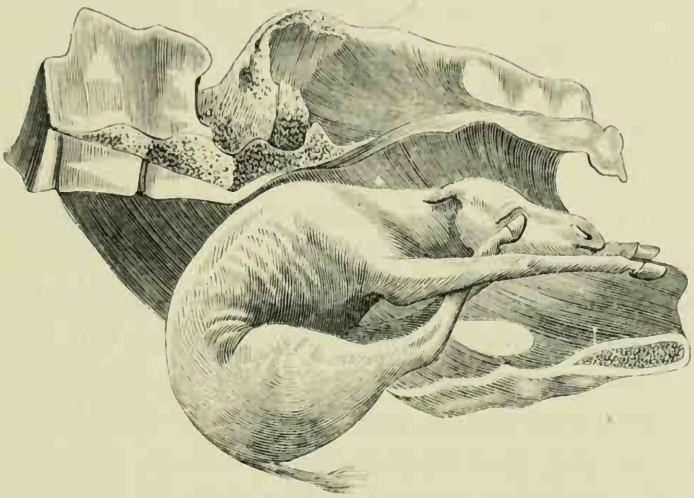

FIG. 94.—DEVIATION OF THE HIND-LIMBS IN THE PELVIS IN THE ANTERIOR PRESENTATION. (SAINT-CYR.)

As a rule the young animal in this presentation perishes, the foal almost certainly; and even the calf, if it is alive, has usually to be sacrificed to save the mother.

Indications.—Exceptionally it is possible to rectify the deviation of the hind-limbs if the fœtus is not far advanced in the pelvis. This may occasionally be accomplished by pushing the fœtus towards the uterus, introducing the hand between it and the wall of the vagina, to carry the hind-feet back, one after another, into the uterine cavity, either by hand or with the aid of the repeller. Care must be taken to prevent the feet rupturing the uterus. Afterwards birth can be readily effected. Retropulsion may be recommended if there is only one hind-limb in the passage. As a rule, however, the veterinary obstetrist finds that parturition has made

much progress, that the fœtus is jammed in the pelvis, that the labour pains are excessive, and that it is impossible to manipulate the hind-limbs.

In some cases it has been possible to effect delivery by cording the hind-limbs if they are not advanced very far, and then pulling them upwards until the feet reach below the wings of the atlas, but not beyond. Traction now being made simultaneously on all the limbs and the head, the fœtus may be delivered. Obich succeeded in extracting a foal in this way.

Embryotomy must be adopted in the majority of instances, and the method adopted by Cann has been found the most successful in the mare and cow. His directions are as follows :

1. Find the hind-limbs, and secure them by cords round the pasterns.

2. Cord the head and fore-limbs, and pull these out as far as possible beyond the vulva.

3. Remove the abdominal viscera, and divide the spine as near the lumbar region as possible, taking the precaution to leave a good piece of skin attached to the loins, so as to cover the exposed bones and prevent the maternal organs being injured during the subsequent steps in extraction. Then remove the anterior portion of the body by traction.

4. Obtain a solid bearing on the divided spine, either with the hand or the repeller, and push steadily and firmly against it, so as to direct it into the uterus, when the cords on the hind-pasterns are pulled by assistants, guided by the hand of the operator, and the presentation converted into a posterior one. This part of the operation is the most difficult and fatiguing for the obstetrist, as well as the most dangerous for the mother, and requires both strength and dexterity to push back the loins and pelvis of the fœtus, while advancing the hind-limbs, thighs, and croup, towards the outlet.

5. Nothing now has to be done but to exercise moderate traction, and so terminate the delivery.

B. Abnormal Anterior Presentation.

SECTION I.—DYSTOKIA DUE TO THE FORE-LIMBS.

These deviations of the limbs are of special importance in the larger domesticated animals, and may seriously hinder birth when they are not adjusted. The principal deviations are generally four in number. (1) The fore-limbs incompletely extended in the pelvis; (2) crossed over the neck; (3) bent at the knees; (4) completely retained. Each of these misdirections may be met with in the four principal positions of the anterior presentation, and one or both limbs may be involved. In the latter case, the direction may be the same or different. The cause is not well ascertained. It may be due to displacement during the changes occurring in the position of the fœtus before birth.

One or Both Fore-Limbs crossed over the Neck.

This complication is not very uncommon in the mare, but is less frequent in the cow. Generally one limb only is carried over the neck.

It is undoubtedly in many instances an obstacle to parturition, as the shoulders are no longer lodged in the hollow space at each side of the neck, but are fixed at the side of the chest, the transverse diameter of which they increase. The obstacle is still greater if one or both of the limbs should chance to cross towards the summit of the head. At all times the complication is more serious if the labour pains are violent and irregular, as they generally are in the mare when there is any impediment to birth. Then there only too frequently result laceration of the roof of the vagina, perforation of the rectum, rupture of the perinæum. Even in favourable cases labour is protracted, and contusions of the genital canal are almost unavoidable. Only occasionally does birth take place without assistance.

In a case of dystokia the condition is recognized by a careful examination of the fœtus. The hand will find in the vagina the head, and perhaps one fore-limb, in the usual position, and the other limb feeling as if shorter, higher up, and crossing the neck towards the fetlock joint.

Indications.—When only one limb is crossed, reduction is not difficult, and may be effected in the pelvis. The leg is seized a little above the fetlock, raised, drawn to its proper side, and extended in the genital canal. Delivery may then be easily effected.

When both fore-limbs are crossed, and the fœtus is not too far advanced in the pelvis, cords should be fixed to the pasterns and the trunk pushed into the uterus. Assistants then pull moderately at the cords, and in such a manner as

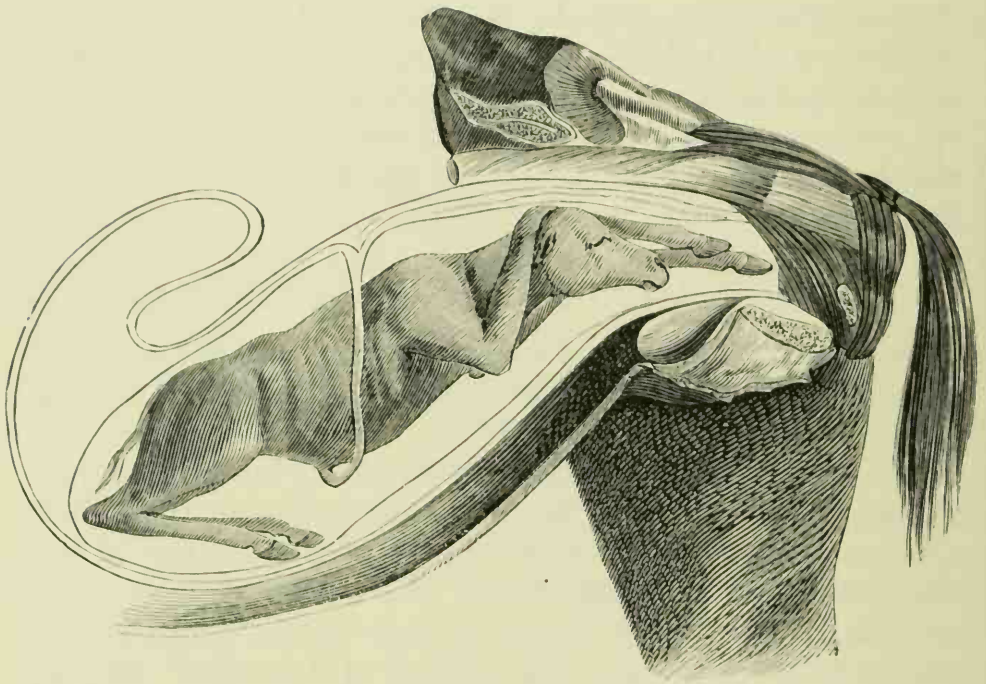

FIG. 95.—ANTERIOR PRESENTATION: FORE-LIMB CROSSED OVER THE NECK.[1] (SAINT-CYR.)

to bring each limb to its own side, if the hand of the operator cannot effect this in the uterine cavity. In this way the limb is brought to its proper positior

Fore-Limbs incompletely extended.

This accident would appear to be most frequent in the cow, and is due to the legs not advancing with the head in the ordinary way, after they have entered the inlet; so that the

[1] In this figure the anterior limbs, especially the right one, are inaccurately drawn by the artist. They are too long, and the right leg should be shown as crossing the neck at the fetlock-joint.

elbow-joints, instead of being in front of the thorax, are alongside of it, and they and the chest are intercepted at the inlet. It occurs when the fœtus is in the vertebro-sacral position, and should not be considered serious if the case has not been tampered with. Its occurrence is recognized by the nose and the feet being together, or the former may even be in advance of the latter.

Indications.—To bring the legs straight into the vagina is the object to be attained ; and if the body and limbs are not firmly fixed in the maternal pelvis, this can be accomplished without much trouble. But when they are tightly wedged in the passage, then there is more difficulty in releasing them. In any case the lower jaw and feet should be corded ; this being done, the chest is pushed forward into the uterus, when the upper parts of the limbs accompany it. The hand can now fully extend the legs, and bring them into the vagina along with the head, and traction will complete the delivery.

One or Both Fore-Limbs flexed at the Knee.

The fore-limbs flexed at the knees, and fixed under the neck and chest, are a very frequent and often troublesome complication. It is generally found in the mare and cow. When it occurs in the sheep and goat, it is rarely of any importance, as delivery can usually take place without assistance. In the young of carnivora and swine, the metacarpal bones are too short to offer any obstacle when the knees are flexed.

One or both limbs may be flexed, and this misdirection may occur in all the positions of the anterior presentation, but chiefly the dorso-sacral position.

One explanation of the condition is that the limbs of the fœtus are not quite extended as they approach the pelvic inlet, and the feet are caught at the anterior border of the pubis and there remain ; the head enters the pelvis, and as it proceeds the limbs become flexed ; the knees are bent, and are applied against the neck.

The other explanation is that the fœtus prior to parturition lies on its side, with the limbs flexed under it ; and this abnormality results because the position is imperfectly

changed, especially if the fœtus dies and the fore-limbs remain flexed.

Such a deviation of the limbs is always a serious cause of dystokia, not so much from the increased volume that the doubled-up limbs give to the neck, as because the arms, incompletely extended on the shoulder, retain the latter against the thorax, and prevent their being lodged in the depression at the base of the neck, thus augmenting the vertical and transverse diameters of the chest, while at the

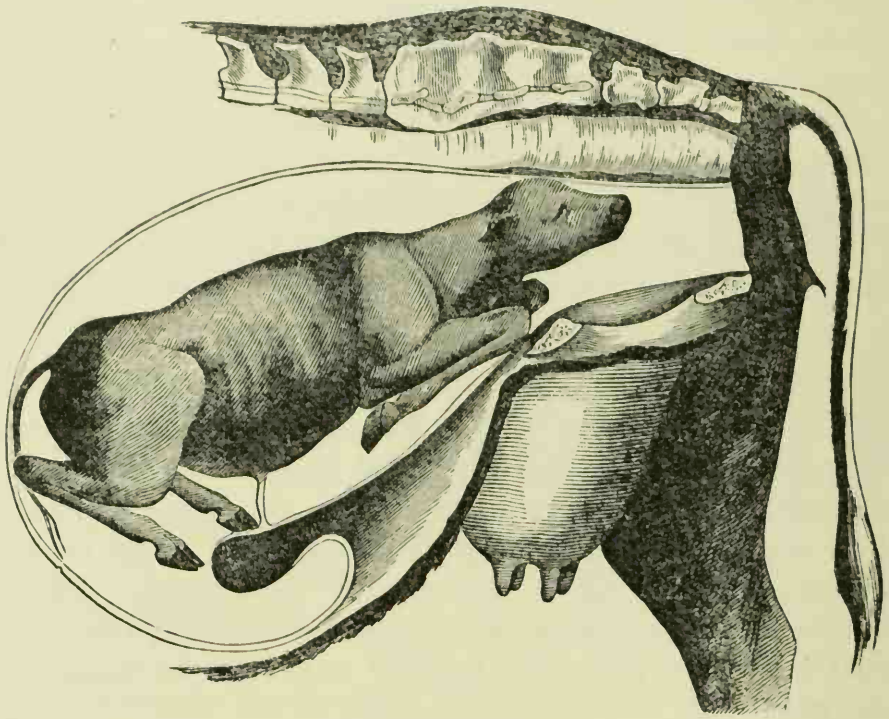

FIG. 96. — ANTERIOR PRESENTATION, DORSO-SACRAL POSITION: FORE-LIMBS FLEXED AT THE KNEES. (SAINT-CYR.)

same time the projecting elbows press against the border of the pelvis.

The case is not so serious when only one limb is flexed at the knee. To make a diagnosis a vaginal examination is necessary.

Indications.—First some lubricant, such as linseed-tea, must be injected into the vagina and uterus. If the fœtus is not jammed in the pelvis, the fœtus must be pushed back into the uterus, to acquire room for the adjustment of the limbs.

Repulsion is facilitated by having the hind-quarters of the animal higher than the fore. For the adjustment of the limb, it is most convenient to use the right or left hand and arm for the corresponding limb. The hand is passed alongside the neck of the fœtus, the forearm of the latter seized in the middle, the knee drawn towards the pelvis while the elbow is pushed upwards and backwards. The metacarpal bone is then seized and moved in the same manner, the knee raised as high as, or even higher than, the point of the shoulder, and the foot to the level of the maternal pubis. The foot is grasped in the hand, flexed strongly on the fetlock and pastern, and drawn into the genital canal. The limb is then extended towards the pelvic outlet, and, if necessary, a

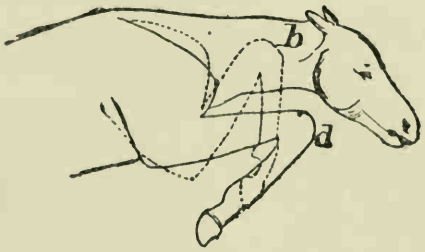

FIG. 97.—ANTERIOR PRESENTATION: EXTENDING THE FORE-LIMB. (FRANCK.)

cord is placed around the pastern, the other limb, if also flexed, being then sought for and treated in a similar manner, and afterwards delivery is easily brought about with or without traction.

It is not commonly possible to extend the limbs in the pelvis, although it has been done in the cow. In a few cases where the fœtus is small, it may be removed by traction, after fixing cords around the knees and to the jaw, without correcting the position of the limbs.

Harms advises, in the case of one limb bent at the knee, that if this cannot be extended it should be pushed forward under the abdomen by the crutch which is applied to the humerus, the other limb and the head being corded, and then traction employed.

When the head of the fœtus extends beyond the vulva, and repulsion is difficult, as occurs frequently in the calf, because of the prominent poll, Williams recommends decapitation.

Afterwards the fœtus may be pushed into the uterus and the position of the fore-limbs corrected. In those cases where repulsion is impossible, it may be necessary to remove one of the fore-limbs at the knees, or, if possible, at the shoulders, to permit of delivery.

When this abnormality occurs with the fœtus in the dorso pubic or dorso-ilial position, which is rare, the indications are similar to those already described. As a rule correction and delivery are easier. In the dorso-ilial position, after adjust-

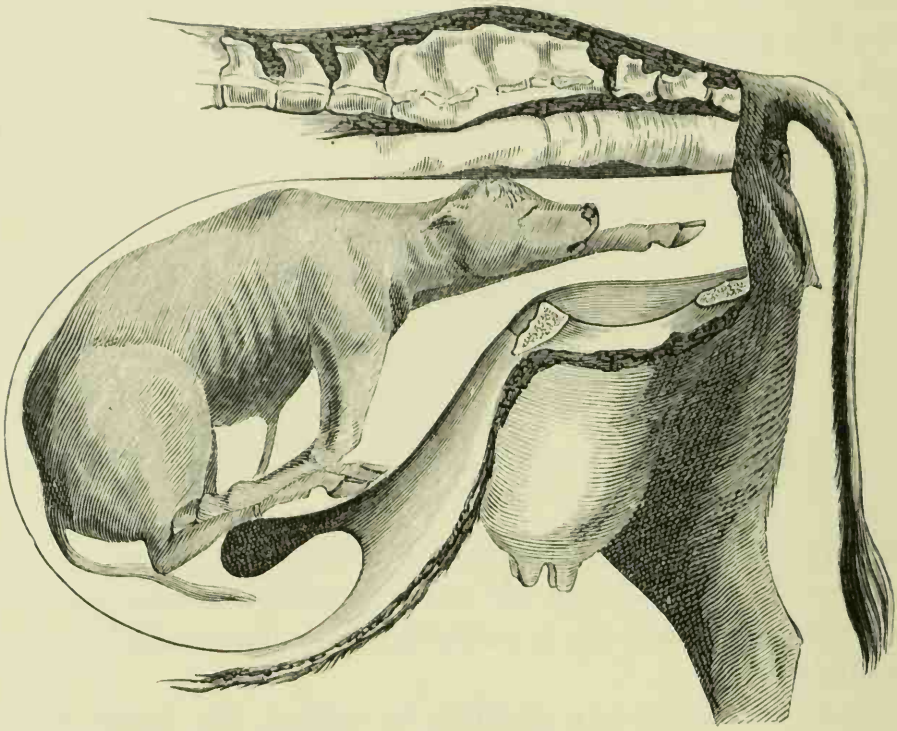

FIG. 98.—ANTERIOR PRESENTATION, DORSO-SACRAL POSITION: ONE FORE-LIMB COMPLETELY RETAINED. (SAINT-CYR.)

ment of the uppermost limb, the fœtus is rotated on its long axis and brought into the dorso-sacral position, in order to allow of the correction of the direction of the other leg.

One or Both Fore-Limbs completely retained.

The complete retention of one or both fore-limbs of the fœtus in the uterine cavity is often met with in the domesticated animals, but more frequently in the mare than the cow or other creature. It is always a serious cause of dystokia,

and occurs usually in the dorso-sacral position, occasionally in the other three positions. Rarely, when the fœtus is small and one or even both limbs displaced, the foal or calf is born without injury to mother or offspring.

But when the fœtus is large and the pelvis narrow, then birth, especially of the foal, is impossible.

Death of the fœtus is the rule in shoulder presentations.

With the smaller ruminants, owing to the formation of the pelvis, birth is not often impeded. With the sow and carnivora, this might almost be called a normal presentation.

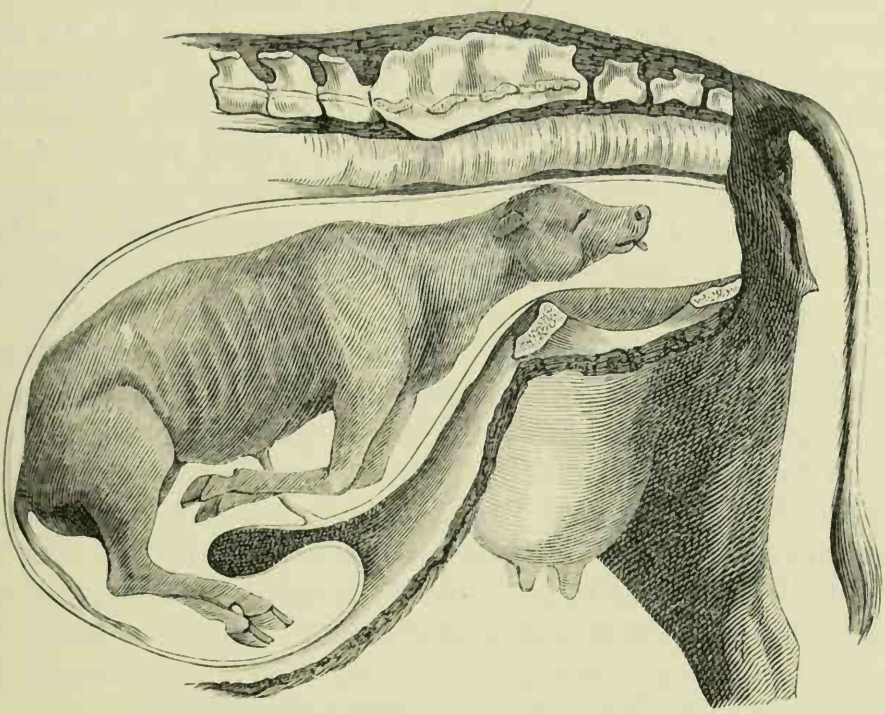

FIG. 99.—ANTERIOR PRESENTATION, DORSO-SACRAL POSITION: BOTH FORE-LIMBS COMPLETELY RETAINED. (SAINT-CYR.)

The shoulder or shoulders, pushed back on the sides of the chest, is the cause of dystokia. It increases the transverse and vertical diameters of the fœtal chest.

On exploration in this complication, the head is found to be in a good direction at the entrance to or in the pelvis, or at the vulva. If only one limb is completely retained, the other will be found alongside or under the head. If both are retained, then nothing can be discovered of them until the uterus is explored. At each pain the head of the fœtus is

propelled outwards, but as soon as this ceases it recedes again, as if thrown back by a spring.

With small-sized cows, the hand introduced into the uterus may find the extremity of the fore-limb; but in large cows and in the mare, particularly if the abdomen is pendulous, the limbs can only be reached with difficulty. They are usually found in one of three positions: Directed nearly vertically downwards, the forearms resting against the brim of the pubis; lying beneath the abdomen; or closely applied against the walls of the chest and flanks.

Indications.—The fœtus, if in the pelvis, must first be repelled into the uterus, forwards and upwards. As the repulsion proceeds, the forearm of the retained limb comes within reach. A cord should be applied to it, with a running noose, as near the carpus as possible. Then traction must be applied to bring the knee into the same position as in the preceding dystokia, and afterwards manipulation carried on in the same way. This is more difficult in the mare than the cow.

Sometimes the fœtus is so much engaged in the pelvic canal that retropulsion is impossible. If the fœtus is small and only one limb retained, it may be possible to deliver the fœtus by traction, especially in the sheep and goat. Where that does not succeed, decapitation is advised, taking care that the ends of the vertebræ are left covered by the skin of the skull, to prevent laceration. Then retropulsion is possible, the limbs can be extended, and extraction may be effected.

Rarely does the last procedure fail. When it does, it is necessary to amputate one or both fore-limbs at the shoulder, where they can be reached. The mastoido-humeralis and muscles to the inner side and upper border of the scapula are cut through, a cord fixed by a noose to the upper extremity of that bone, and by traction the limb removed. If that is not sufficient to permit of extraction, evisceration must be carried out and the young animal taken away in pieces.

SECTION II.—DYSTOKIA DUE TO THE HEAD.

Obstacles to parturition from a wrong direction of the head are quite as frequent as, and more serious than, those due to misdirection of the fore-limbs In the mare, because of the

long neck of the fœtus, the head is carried even as far as the flank, while with the calf it seldom goes beyond the shoulder. Hence in the former animal the condition is the more serious. In the pig, because of the short neck, this deviation seldom occurs.

Misdirection of the head usually takes place immediately preceding or during parturition ; occasionally long before this, where the neck and head are deformed and bent laterally, as described under " Contractions."

Deviations of the head may be met with in the four principal positions of the anterior presentation, and they may occur alone or be complicated with misdirection of the fore-limbs.

Downward Deviation of the Head.

In this abnormality the nose is towards the trachea, and the poll or upper ridge of the neck presenting. It perhaps occurs oftenest in the cow, and usually in the dorso-sacral position. It is the usual deviation of the head in hydrocephalus. This deviation is believed to occur when the fœtus is entering the pelvis. If the head is not exactly in the axis of the inlet, but is inclined a little downwards and flexed, the nose comes in contact with, and is retained by, the brim of the pelvis. The uterine contractions force the fore-limbs, if favourably placed, into the genital canal, and the head becomes more and more flexed, until the face becomes horizontal, and rests on the floor of the pelvis of the mother, the lower jaw against the trachea.

The diagnosis of this deviation is not difficult. On vaginal exploration, the feet, if the limbs are in their proper position, will be first found, and nearer the uterus, between the fore-limbs, the nape of the neck, the ears and eyes, and the fore-lock and mane, if a foal.

Indications.—The hind-quarters of the mother should be elevated, by extra bedding, to the extent of one or more feet. An attempt must then be made to correct the direction of the head. This is not difficult if the head is not engaged in the pelvic inlet. The operator passes his hand along the floor of the vagina into the uterus, between the maternal pubis and the forehead of the fœtus, downwards towards the nose,

This is received in the hollowed palm, and raised above the pubic brim by flexing the wrist and drawing it towards the vulva. Then delivery is easily effected. With the calf, because of the large size of the muzzle, it is better to introduce the fingers into the mouth for obtaining a grip, or to seize the nose by pushing the index-finger and thumb into the nostrils.

When the nape of the neck is firmly engaged in the inlet, and there is no room to adjust the head, which is jammed against the maternal pubis below and the sacrum above, delivery may be effected by passing a running noose of a cord

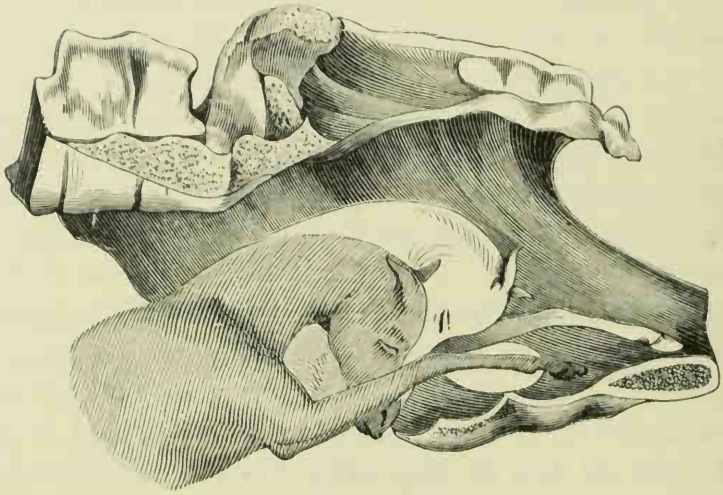

FIG. 100.—ANTERIOR PRESENTATION, DORSO-SACRAL POSITION: DOWNWARD DEVIATION OF THE HEAD. (SAINT-CYR.)

round the nose or upper jaw of the fœtus. While an assistant pulls at this cord, the operator, by pressing strongly against the top of the head, makes this swing backwards, the nose rising into the passage, and birth is soon accomplished.

Delivery may occasionally be brought about without adjustment of the head, even in the foal. Lecoq gives an instance in which the upper part of the head and poll were so firmly fixed in the pelvis that it was impossible to push the fœtus into the uterus. This was attempted, however, by squeezing the head closely to the neck, the hand being passed alongside the cheek and the nose gradually raised. At the same moment the mare strained doubly hard, and gentle traction being applied, the foal was expelled with its head in this position, but without injuring the perinæum of the mother.

The mare did well, but the foal was dead. Such an operation, however, is not likely to be successful if the fœtus is large.

In the dorso-pubic position, after correction of the direction of the head in the uterus, efforts may be made to place the fœtus in the dorso-sacral position. When rotation is accomplished, delivery is easily effected. With the smaller animals, forceps or hooks will be required to correct the position of the head.

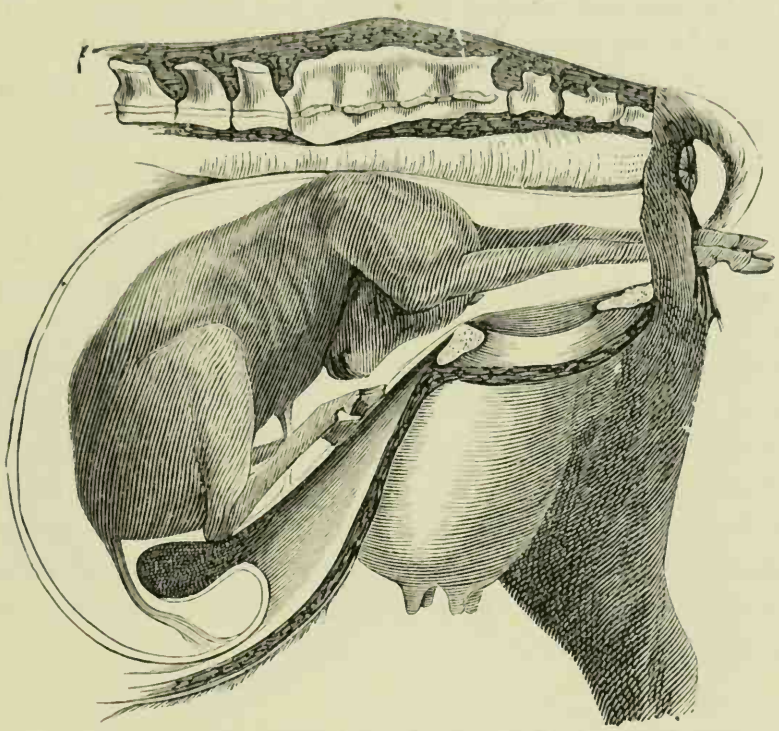

FIG. 101.—ANTERIOR PRESENTATION: EXTREME DOWNWARD DEVIATION OF THE HEAD. (SAINT-CYR.)

Head bent under the Body

This is an exaggerated, but much more serious, form of head and neck flexure, especially in the mare, and it occurs in a similar manner to the preceding. The head is pushed lower and more under the neck until it gets beneath the chest, and even the abdomen, where it may deviate to one side. The fore-limbs are in the genital canal.

The accident is discovered by manual exploration. The fore-limbs being followed by the hand, the crest of the neck is found pressed against the pubis, while the head can be

traced by the ears and the orbits, the face being towards the floor of the uterus; or the hand may discover the nose and mouth inclined upwards at one side of the chest, behind the elbow.

In this position birth is impossible, as straining and traction only make matters worse.

Indications.—An attempt should first be made to correct the direction of the head. The preliminary steps should be taken as in the preceding case. The crutch in retropulsion should be applied to the shoulder, not to the neck. A cord should then be applied, if possible, to the lower or upper jaw or round the head, or a blunt hook inserted into the mouth or orbit and traction applied. Placing the animal on its back has in some cases facilitated the work of correcting the direction of the head.

If these methods fail after a reasonable trial, then embryotomy should be employed. It should be resorted to early if the fœtus is dead.

One fore-limb should be removed, and this as a rule permits a cord to be passed round the bend in the neck, and traction brings the head nearer the inlet, where it may be possible to turn it into the genital canal. Then extraction of the fœtus is easy. Another method consists in severing the vertebral column at the base of the neck. This increases the mobility of the head and facilitates the correction of the presentation.

Lateral Deviation to the Right or Left.

The lateral deviation of the head to the right or left side of the body, whereby the left or right side of the neck presents at the pelvic inlet, is a very serious obstacle to birth, and is only too frequently one of the most difficult to overcome. It is one of the most frequent deviations, and occurs much more often in the mare than in other animals.

Lateral deviation of the head is, in many instances, due to precipitate or tumultuous birth, when the os is either imperfectly or not at all dilated. The uterine contractions propel the head of the fœtus towards the pelvis, but, as the os is not open, the body pushes the nose against either the pelvis

or the occluded os, and it turns to one side. Then the deviation becomes increased at every contraction.

The accident appears to be most frequent with primiparæ. Saake found 84 out of 108 cases in animals pregnant for the first time.

The deviation is more serious when the fœtus is dead. If it is alive, it gives assistance in reduction of the abnormality. When the deviation is slight, the head fitting into the concavity on the side of the neck, birth occasionally occurs without

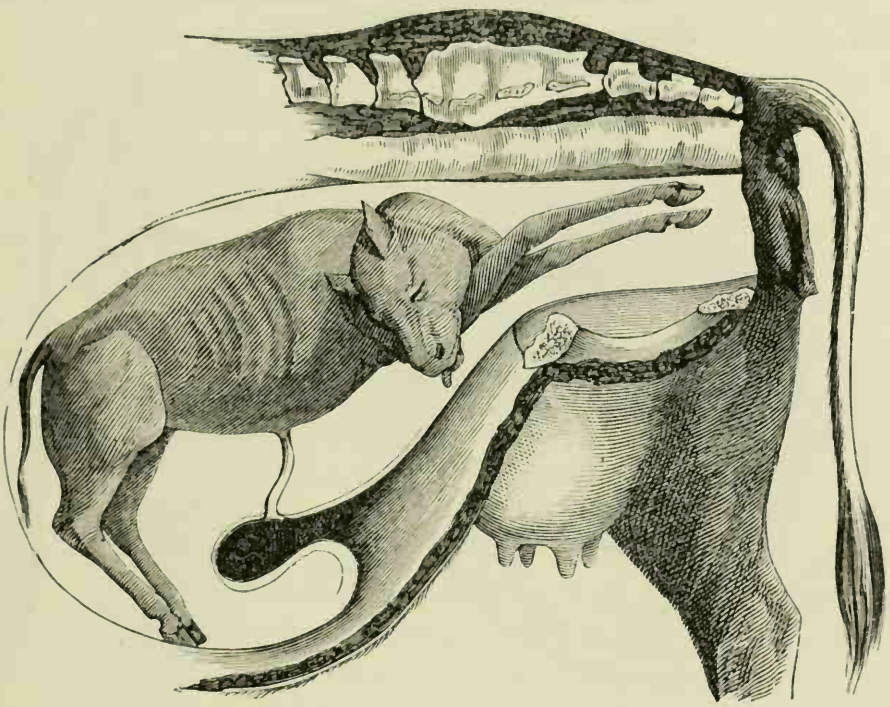

FIG. 102.—ANTERIOR PRESENTATION, DORSO-SACRAL POSITION: LATERAL DEVIATION OF THE HEAD TOWARDS THE SHOULDER. (SAINT-CYR.)

assistance, particularly with the foal, which has a longer and thinner neck than the calf.

This deviation in many foals cannot be straightened. This condition has been described under "Contractions of the Fœtus."

The diagnosis of this form of dystokia is made by vaginal exploration. Usually both fore-feet are in the genital canal, but birth does not progress. The limb belonging to the side to which the head is bent is less advanced than the other. The hand in passing towards the inlet comes in contact

with a convex mass (the bent neck), rendering access to the uterine cavity difficult.

With the calf, owing to the shortness of the neck, it is easy to discover the head by the ears, eyes, and muzzle, lying towards the shoulder. With the foal, because of the much longer neck and the more violent uterine contractions of the mare, the head cannot be reached, as it lies on the thorax, the abdomen, flank, or croup, especially if the abdomen of the mare is pendulous. The neck may be identified by the mane

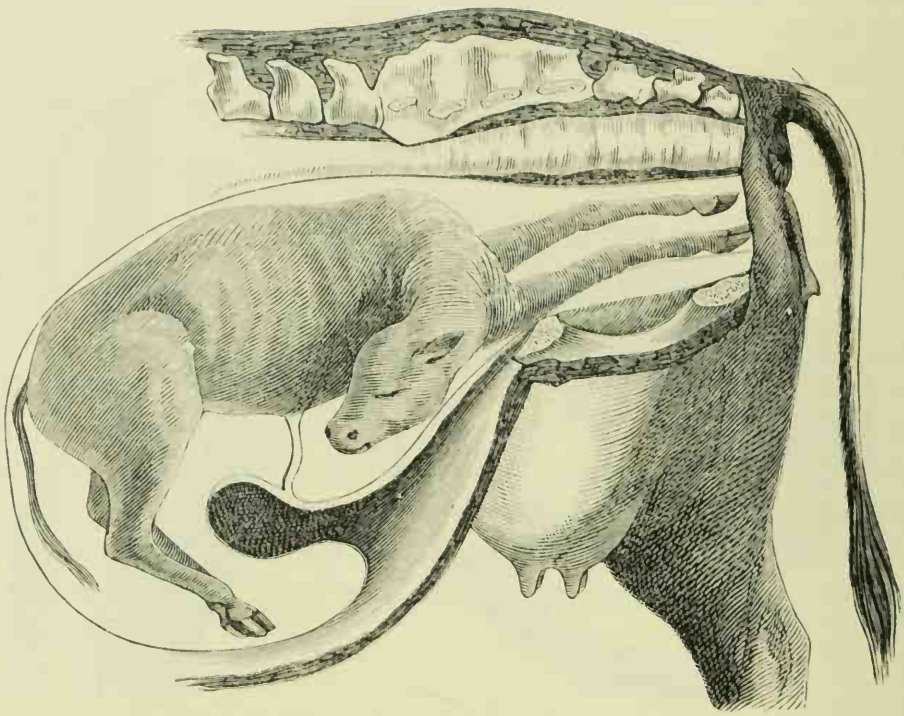

FIG. 103—ANTERIOR PRESENTATION: LATERAL DEVIATION OF THE HEAD TOWARDS THE ABDOMEN. (SAINT-CYR.)

above and the trachea below. If the mother is lying on the side to which the head is turned, it is most difficult to reach the latter, even if it lies only on the shoulder.

The head may be raised as high as the back, or lie as low as the under-part of the chest or abdomen. The fœtus is usually in the first (or dorso-sacral) position, occasionally in the dorso-pubic or dorso-ilial.

As a rule reduction of the displacement is indispensable to delivery, the head and neck or shoulder forming too voluminous a mass to pass through the pelvic canal.

Indications.—The first indication is—Adjust the head and bring it into a favourable position in the genital canal, and then effect delivery. But one must keep in mind "wryneck" in the foal, which cannot be adjusted, and is distinguished by its immobility.

For the purpose of adjustment the hind-quarters of the animal are raised, a lubricant injected into the uterus, and repulsion applied to the chest, and directed towards the opposite side from the deviation. Some portion of the head, such as the nostrils and commissure of the lips, should, if accessible, be grasped and pulled sharply. When the head is not accessible, then it is difficult, if not impossible, to straighten the neck.

When it is found impossible to effect adjustment of the head and neck as in wryneck, then recourse must be had to forced extraction or embryotomy.

The first method should not be employed unless the fœtus is alive and the pelvis of the mother large. Successful forcible extraction has been reported, especially in the mare, by Darreau, Donnarieix, and others.

Donnarieix operates as follows: The mare is thrown down near the stable door, the thighs propped against the threshold, and a breeching and side line, fixed to the wall or held by assistants, may be employed to keep the animal in position. Each fore-limb of the fœtus is corded at the pasterns, the cords being confided to assistants, the number of which will vary according to the amount of resistance; four at least are necessary, and sometimes six or eight. On the word being given, these men pull slowly, steadily, and gradually, without jerking, and equally on both cords. The foal enters the inlet, but it often happens that at a given moment it stops there, owing to the uterus forming a double fold or ring at this part, and opposing progression. Traction must then cease, but the fœtus is to be held firmly in the position to which it has advanced; the hand is to be introduced between the latter and the uterus—the back of the hand to the fœtus, palm to the mucous membrane—the fold sought for, and dispersed by raising the back of the hand. Then the tractions are to be renewed, and in the course of fifteen, ten, or even fewer minutes the foal is extracted. It is well to empty the rectum

before commencing extraction. With this method there is a serious danger of rupture of the uterus and perinæum.

Embryotomy is much to be preferred to forced extraction, both in the mare and cow. It should be resorted to as quickly as possible when the fœtus is dead, or the head cannot be reached and adjustment is impossible. The more advanced limb—*i.e.*, the one on the opposite side from the head—should be removed subcutaneously at the shoulder. Sometimes that is all that is necessary to allow the head to be adjusted, or, at any rate, to permit of delivery. With the calf both limbs have usually to be removed; or one limb removed, the thorax opened, and evisceration carried out. Frequently then the head and neck can be put straight, and in any case the fœtus may be removed by traction.

In the dorso-pubic or dorso-ilial positions, the deviations should first be corrected and then rotation practised. The other indications are similar to those noted for the dorso-sacral position.

If misdirection of one or both fore-limbs complicates this condition, then the limbs must first be adjusted before dealing with the head and neck. The feet and head should be secured with ropes as early as possible.

With the ewe and goat this deviation must be remedied by forced extraction with the short blunt hook or finger hook, the fore-limbs of the fœtus being manipulated so as to push away the unencumbered shoulder into the uterus, and bring forward that round which the neck bends. A small hand may be inserted to correct the wrong direction of the neck.

With the bitch and sow these deviations are extremely rare. When they do occur, a lubricant should be injected, the hind-limbs raised, and the fœtus pushed back with the tip of the fingers into the uterus. Sometimes manipulation of the abdomen by the hand permits of correction of the direction of the head, and causes it to pass into the pelvis, where it is extracted with the aid of blunt hooks and forceps.

Where manipulation does not cause any improvement, hysterectomy or the more risky Cæsarian section should be resorted to before the fœtus undergoes decomposition or the mother becomes exhausted.

Deviation Upward and Backward.

The deviation of the head more or less upward and backward—the inferior borders of the lower jaw being vertical or turned towards the maternal sacrum—is an extremely rare condition, and is chiefly met with in the mare, in which it has led to rupture of the uterus and rectum, and delivery by the latter.

The cause is probably the same as in other deviations of the region.

On exploration, if the fœtus is in the dorso-sacral region,

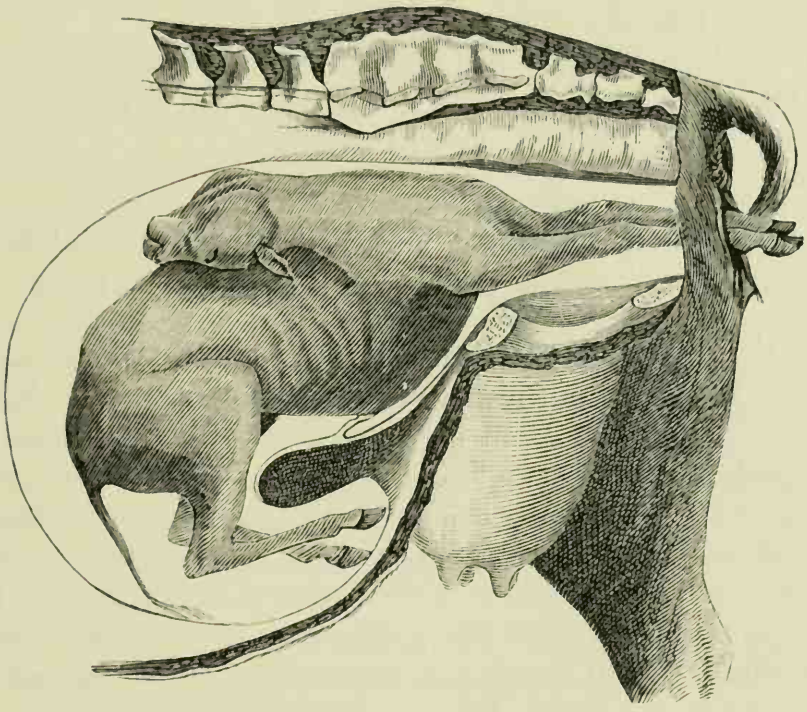

Fig. 104.—Anterior Presentation, Dorso-Sacral Position: Deviation of the Head Upwards and Backwards. (Saint-Cyr.)

the fore-limbs may be found more or less advanced in the vagina, and beyond them, at the inlet, the hand meets the sternum; while above it is the front part of the neck, with the trachea leading upwards to the head, which may be bent more or less back on the withers or loins, or inclined to one side of the fœtus, the lower jaw always facing the lumbo-sacral region of the mother, or twisted slightly round.

Indications.—First retropulsion should be practised on the sternum of the fœtus, and this alone will often bring the head

into the normal position. Should the head not drop down to the pelvic inlet, then, still continuing the retropulsion, the hand may be introduced, the lower jaw seized or corded, and brought towards the os by a slight screwing motion. If this cannot be done, or does not effect the required purpose, an incision may be made on the side of the neck, a blunt hook inserted at the point of incision, and traction applied. As the head moves the hook may, if necessary, be inserted further forwards in the neck and later into the orbit. In this way the head may be turned to its normal direction.

Embryotomy is rarely necessary, but if adopted is carried out as for lateral deviation.

In the bitch delivery has been effected without reduction of the deviation. If delivery is unsuccessful, then hysterectomy should be performed as early as possible.

DYSTOKIA IN THE POSTERIOR PRESENTATION.

A. Natural Posterior Presentation.

In the posterior presentation only one position is compatible with spontaneous and natural delivery—the lumbo-sacral; but this is only possible when the hind-limbs are extended backwards, and are the first to enter the genital canal, so as to gradually dilate the channel for the passage of the voluminous and rounded croup. Birth in this position, and without assistance, is more frequent in the bovine than the equine species, and the young creature is nearly always born alive. When traction is required to assist delivery, the mortality in the newly born is greater than in anterior presentations. This increased mortality is ascribed to delay in delivery and hence a greater liability to asphyxia.

SECTION I.—DYSTOKIA FROM ABNORMAL POSITIONS.

Lumbo-Pubic Position.

In this, the posterior reversed position, the fœtus is lying on its back, its croup and loins towards the floor of the abdomen or pubis of the mother, with its feet and belly towards the sacrum.

The obstacle to birth lies chiefly in the thighs and buttocks,

which have some difficulty in clearing the pubis, while the body of the fœtus itself forms a curve reverse to that of the pelvis, and the hind-feet project against the mother's sacrum, and, in addition to increasing the resistance, threaten to lacerate the vagina, and even rectum. The position is more commonly met with in the mare than the cow.

Indications.—Rotation of the fœtus should be practised in this position, so as to convert it into a lumbo-ilial or even a lumbo-sacral position. This is especially required in the cow, because of its narrow pelvis. Some authorities recommend that delivery should be effected without rotation, but that can take place only when the pelvis is large. In this case the hind-feet must be carefully guided through the genital canal until they are external to the vulva, so as to avoid laceration and rupture of the walls of the vagina and rectum. The pasterns of each hind-limb should be corded; then the hand must be passed along the flexor tendons until the point of the hock is reached, this part usually jamming against the brim of the pubis; this hock is now raised, and at the same time the corresponding cord is pulled gently backwards and slightly downwards, so as to bring the calcis into the vagina. This operation is to be repeated on the other limb, and then both feet are to be directed by the hand through the canal. The cords should then be pulled upwards, so as to raise the croup and facilitate its entrance into the inlet, after which steady traction may be employed during the labour pains to bring about delivery.

In the lumbo-supra-cotyloidean and lumbo-ilial positions, which are uncommon, dystokia occasionally occurs. The chief obstacle is the jamming of one haunch against the brim of the pelvis.

The same indications apply as for the lumbo-pubic positions.

SECTION II.—DYSTOKIA DUE TO THE HEAD OR FORE-LIMBS.

Head and Contracted Neck.

The head is bent round on the side, and becomes fixed in the pelvic inlet or retained by the cervix uteri, when this contracts earlier than usual.

This cause of dystokia is very rare. It is occasionally met with in the mare.

One may sometimes, after repelling the hind-quarters from the inlet, find the head at the side of the fœtus.

The fœtus frequently dies during delivery.

Indications.—When the neck is bent or contracted, the limbs should be corded, placed straight in the genital passage, and traction made on them by the cords and hand. If there is difficulty in moving the fœtus, traction should be made on one side, then on the other, by which means progress will be made, and delivery ultimately completed. In rare cases embryotomy must be performed. The fœtus is drawn out as far as possible, and divided at the lumbar region. The remnant is repelled, and an attempt is made to reach the head and correct its position, or amputate it and afterwards deliver the remaining portion.

Sometimes the head itself is very large, especially in the bitch, and causes some difficulty. Then traction will remove it from the canal, after injecting a lubricant, the body of the fœtus being at the same time moved from side to side and up and down, so as to engage the head in the passage by all its diameters.

Fore-Limbs.

It is probable that this presentation is secondary to the sterno-abdominal.

The hind-legs are found in the passage, perhaps projecting from the vulva, one or both of the fore ones being in the vagina, and probably towards the maternal sacrum. Frequently the body of the fœtus is oblique to that of the mother.

Indications.—Retropulsion should be applied to the fore-limbs to push them into the uterus, while the hind extremities, which have been corded, are being pulled on to maintain the fœtus in position.

If that fails, as it sometimes does in the mare, then the fore-legs should be drawn as near the vulva as possible, and amputated either at the carpal or elbow joints. This is often very difficult, and involves laceration of the genital passage.

B. Abnormal Posterior Presentations.

Hind-Limbs incompletely extended in the Genital Canal.

This presentation is somewhat rare, and frequently involves the death of the foal. It is generally due to the prominent stifles being arrested at the inlet by the thin margin of the pubis in the mare, or the inclined plane this part forms in the cow.

When the hind-limbs become fixed, the body of the fœtus continues to pass outwards, so that the femurs become more vertical, and this causes the croup to be raised against the lumbar region, and finally to be jammed there. This accident is much less frequent in the cow than the mare, probably because of the sloping border of the pubis.

Exploration discovers the soles of the hind-feet uppermost, with the hock flexed and the stifles pressing against the margin of the pubis, while beyond this the croup is jammed upon the sublumbar arch.

Indications.—Push the croup forwards in the uterus during the intervals between the pains, while traction is made on the cords which have been attached to the lower portions of the hind-limbs. If the hind-legs chance to be incompletely extended in the lumbo-pubic or lumbo-ilial regions, particularly in the cow, the fœtus should be pushed forwards, its hind-legs extended, and the creature placed in the lumbo-sacral position, when delivery can be completed.

The Two Hind-Limbs are flexed at the Hocks (Hock Presentation).

The fœtus in the posterior presentation, lumbo-sacral position, with the hind-limbs not quite extended, is impelled by the uterine contractions towards the pelvic inlet. The legs come in contact with the pelvic brim below, by the posterior surface of the metatarsus, while the croup encounters the sacro-vertebral angle above. The croup and points of the hocks advance to the os, and the latter joints become gradually flexed, until at last the cannon-bones press against the thighs, and the legs and croup, jammed in the inlet, form too

large a mass to advance farther. In addition, the phalanges of the hind-limbs, owing to the extreme flexion of the hocks, are flexed to a corresponding degree, and so form two hooks which cling to the edge of the pubis. Consequently, birth is impossible without extraneous aid.

Diagnosis.—On exploration, the hocks are found sometimes alone in the pelvis, sometimes in company with the tail and ischial tuberosities.

Indications.—In the sheep, goat, sow, and bitch, the fœtus is often extracted in this malposition.

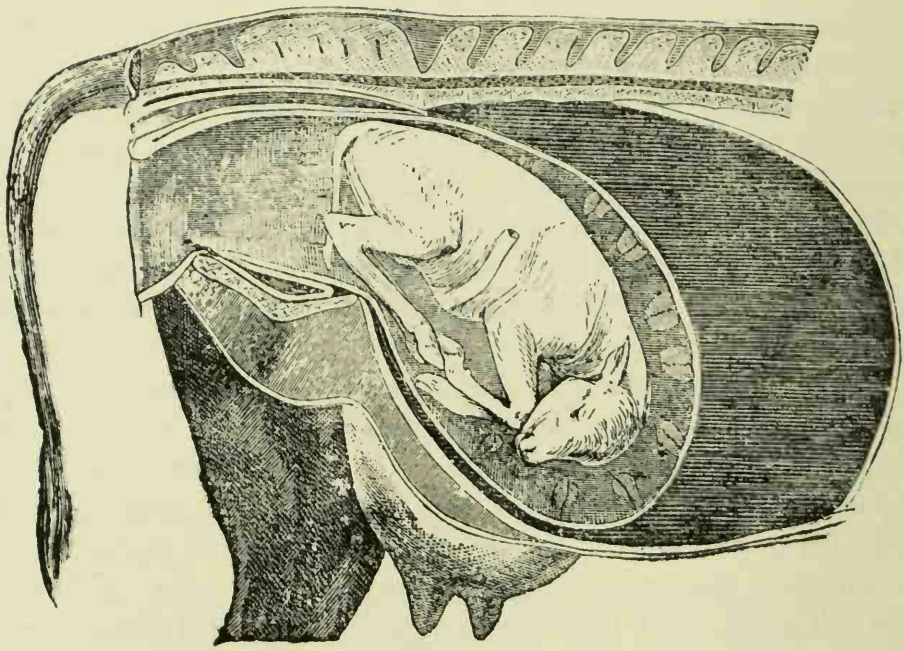

FIG. 105.—HOCK PRESENTATION: CALF. (FRANCK.)

In the cow, and especially in the mare, forcible extraction without rectifying the deviation is attended with serious risk of laceration or rupture of the genital passage.

The method of adjusting the hind-limbs is as follows:

1. Push the fœtus as far as possible into the uterus. This retropulsion can be effected with difficulty, in the mare even at the commencement of parturition, when the fœtus has not yet entered the pelvic inlet, or, at most, the points of the hocks are only engaged. But when the croup is in the passage, the difficulty is greatly increased in the cow, and retropulsion may even be impossible in the mare. It should

always be attempted, however, and in the cow the attempt will generally be successful.

The hind-quarters of the dam must be raised as much as possible, and the hand should be applied against the buttock of the young creature, or a repeller placed across the thighs. The retropulsion should be made by steady pushes in the interval between the labour pains; these pushes should be directed slightly upwards, so as to raise the croup. At first the resistance seems insurmountable, but gradually the fœtus

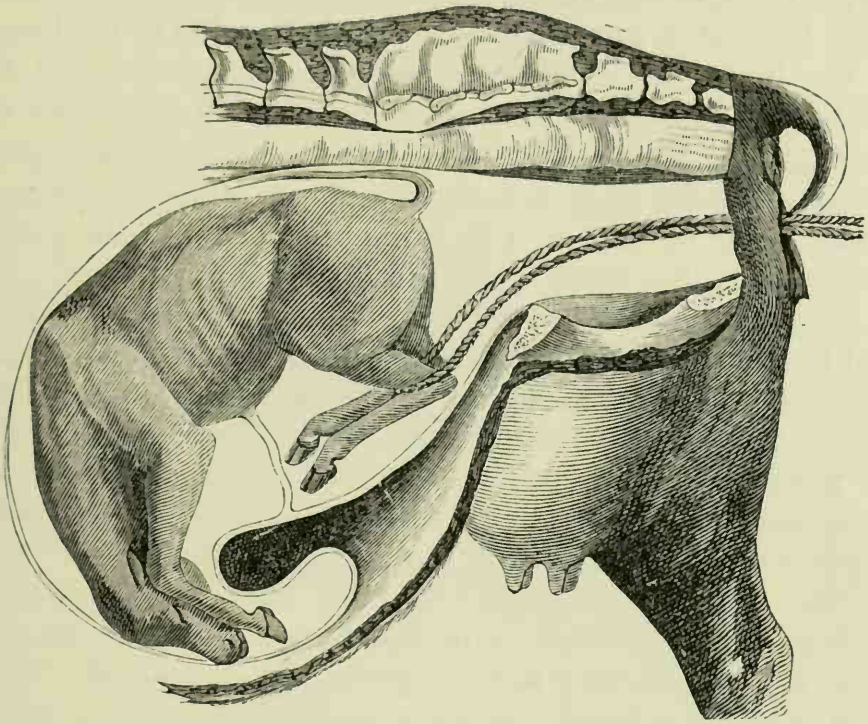

FIG. 106.—HOCK PRESENTATION: HOCK CORDED. (SAINT-CYR.)

begins to move forwards, and finally is propelled to a sufficient distance in front of the pubis to allow the limbs to be extended backwards.

2. Then fasten a cord on each pastern (by means of the porte-cord if necessary).

3. Flex the leg on the thigh as much as possible, raising the point of the hock as near as possible to the buttock. If the labour pains push the fœtus too near the pubis, then it must be thrust forward again by acting chiefly on the point of the hock. When sufficient space has been gained, pass the

hand downwards along the cannon-bone and grasp the front of the foot, the thumb and index-finger meeting round the coronet, so that the toe is in the palm of the hand. By adopting this precaution, danger of injury to the uterus or vagina is averted. The pastern and fetlock are forcibly flexed, and the extremity of the limbs pulled inwards, in the endeavour to throw the hock outwards and prevent it entering the pelvis ; then by a vigorous effort, seconded by traction on the cord applied to the pastern, the foot is raised above the pelvic brim, brought into the vagina, and the leg extended. With the foal, it sometimes happens that, owing to the length of the limbs, the calcis presses against the sacrum of the mother, while the foot jams on the pubis. In such cases the operator may allow the foot to pass from his hand, and press the point of the hock towards the uterus, while an assistant pulls at the pastern cord to bring the foot into the pelvis. The other limb is brought back in the same way.

Embryotomy should be carried out when the fœtus is dead, and is so firmly fixed in the pelvis that it cannot be pushed into the uterus. The hind-limb is amputated at the hock after it has been drawn by hand or cord as near to the vulva as possible. The separated limb is withdrawn from the passage. When both limbs are treated in the same way, delivery can be completed in the ordinary manner.

With the cow, if the calf is alive and impacted in the passage, and the latter is roomy, forced extraction may be attempted, particularly when only one limb is retained. When only one limb is flexed, the leg extended in the vagina should be corded at the pastern, or above the hock if this can be reached. A cord is then to be passed round the bent hock by means of the porte-cord, and traction exercised during the labour pains. If necessary, the gastrocnemius tendons may be severed, to permit of freer flexion of the joints. When both legs are flexed at the hocks, a cord must be passed round each. Should forced extraction not succeed, the limbs may be amputated at the hock as with the mare.

During these manipulations, it should be noted that the tail is in the correct position, directed backwards. If the fœtus is in the lumbo-ilial position, it should be rotated into the lumbo-sacral before attempting extraction.

Hysterotomy or *hysterectomy* may be required in the smaller animals, where embryotomy cannot be easily carried out.

Thigh and Croup Presentation (Breech Presentation).

The cause of this malposition is the same as that operating in hock presentations. The deviation is not at all unusual in mares or cows with a very pendulous abdomen. The hind-legs are flexed more or less under the body.

The tail and buttocks are the first parts that the hand

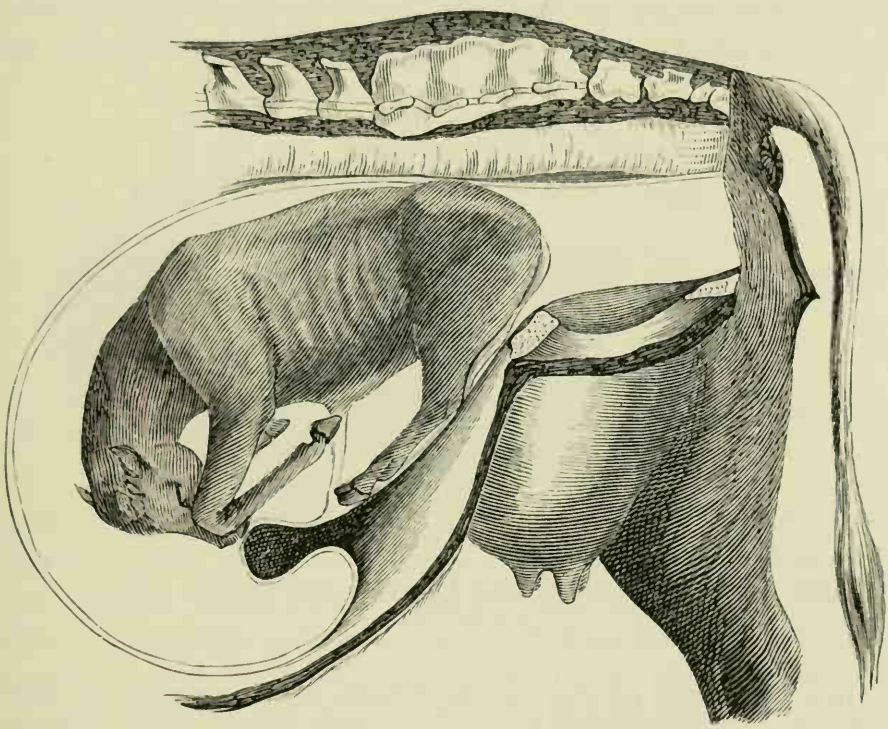

FIG. 107.—THIGH AND CROUP PRESENTATION. (SAINT-CYR.)

encounters in exploring the genital canal, then the croup and haunches. In many cases the limbs are directed so far forwards that the hocks are beyond reach.

Though the croup and haunches may have passed into the pelvic inlet, yet nothing of the fœtus is discernible externally, except perhaps the tail, no matter how long the labour may have been in progress.

This is one of the most difficult malpositions the veterinary obstretrist can encounter. Frequently the mother perishes without being delivered.

Indications.—An attempt should first be made to adjust the direction of the limbs. The animal should be given a sedative, to prevent straining, and the hind portions of the body raised. The fœtus must then be repelled, by hand or crutch, into the uterus sufficiently from the inlet to allow the lower part of the limbs to be seized and brought into the vagina. One of the limbs is seized above the hock, and the thigh and leg flexed as much as possible by lifting that joint towards the mother's sacrum. The rest of the procedure in bringing the foot into the passage is the same as for hock presentation. This manipulation is, however, rendered more difficult from the fact that the hocks are deeper in the uterus, and jam

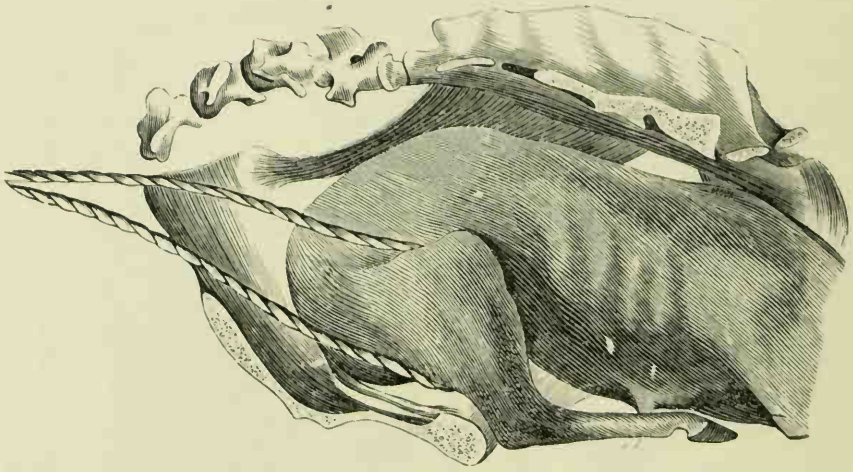

FIG. 108.—THIGH AND CROUP PRESENTATION: THIGH CORDED. (SAINT-CYR.)

against the brim of the pelvis, where they cannot be freed by the hand. The difficulty is surmounted by passing a blunt hook round them, or a cord, the two ends of this outside the vulva being twisted and drawn upwards and outwards by an assistant; while the operator, pushing at the croup, throws the body of the fœtus forwards, and thus allows the point of the calcis to rise above the pelvic brim, when the leg can be extended backwards as in hock presentation.

When this fails, one must resort to forced extraction of the fœtus, or embryotomy.

Forced extraction of the fœtus without adjustment is a very serious, because a very violent, measure, and is frequently fatal to the mother as well as to the offspring. It may

be tried when only one limb is in the abnormal position. In practising forced extraction, a cord may be applied round each of the thighs, or round the abdomen in front of the thighs, and traction applied to these and the tail. Some practitioners use sharp hooks, fixing them to the muscles of the croup, towards the hip-joints; but their use is always attended with risk. Should they slip during traction, or not be carefully implanted in the fœtus, they may do great, if not fatal, injury to the mother. To avoid these dangers, the perinæal region of the fœtus is largely incised, and the hand, armed with a crotchet, is passed into the pelvis by this opening, the crotchet being fixed either in front of the symphysis

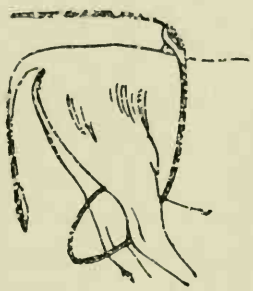

FIG. 109.—THIGH AND CROUP PRESENTATION: BODY CORDED. (FRANCK.)

pubis, on one of the branches of the ilium, or in one of the oval foramina. By this method a more solid hold is obtained, and greater force can be easily exerted. As a rule the success of forced extraction is due either to the small size of the fœtus or a large and well-formed maternal pelvis. It is advisable to give the mare a general anæsthetic during forced extraction.

In *embryotomy* one or both hind-limbs must be amputated at the hip-joint, or else by cutting through the shaft of the ilium and the ischio-pubic symphysis through the perinæum of the fœtus. The disarticulation at the joint or the cutting of the bone may be effected by a curved hook or a long chisel. Afterwards it may be necessary to eviscerate the carcase in order to bring about its complete removal.

The smaller animals—bitch, sow, ewe—may be delivered by the forceps, small hook, or the tube noose to be afterwards described.

Cæsarian section or *hysterectomy* may also, in extreme cases, be resorted to with the bitch and sow.

DYSTOKIA FROM TRANSVERSE PRESENTATIONS.

In the transverse presentations the fœtus has its greater axis transverse, or more or less perpendicular to the antero-posterior diameter of the pelvic canal.

These presentations are much less common than the longitudinal ones, and are more frequent in the mare than the cow, perhaps because of the more energetic contractions of the uterus in the former animal not allowing natural adjustment of the fœtus, should the latter not be exactly in a favourable position when labour commences. They do not appear to be primary. These deviations are more likely to occur if the os does not become sufficiently dilated. They have been noted in torsion of the uterus, spasm of the cervix, deviation of some parts of the fœtus (especially of the head), hydrocephalus, deformed head, etc.

In these presentations birth cannot take place without assistance ; version must be practised to bring one of the extremities of the fœtus toward the inlet.

The transverse presentations are of two kinds—the dorso-lumbar and the sterno-abdominal.

SECTION I.—DYSTOKIA FROM THE DORSO-LUMBAR PRESENTATION.

This presentation is somewhat rare.

In cases of the kind, labour has been going on for some time, the "waters" have escaped, and, though the straining may be very energetic, even violent, yet nothing is seen of the fœtus.

Diagnosis.—When the hand is introduced into the genital canal, it encounters at first a more or less rounded surface, formed by the back of the fœtus curved on its length. One may recognize the withers by the prominences formed by the spinous processes, and by its thin, wedge-shaped outline, by the hair of the mane in the foal. The lumbar region may be distinguished by the large and almost level surface it

offers, the projecting external and internal angles of the coxæ in its vicinity. The dorsal region or back is discovered by the arches of the ribs springing from each side, with the intercostal spaces.

The head and limbs, more or less entangled with each other, are directed forwards and difficult to reach.

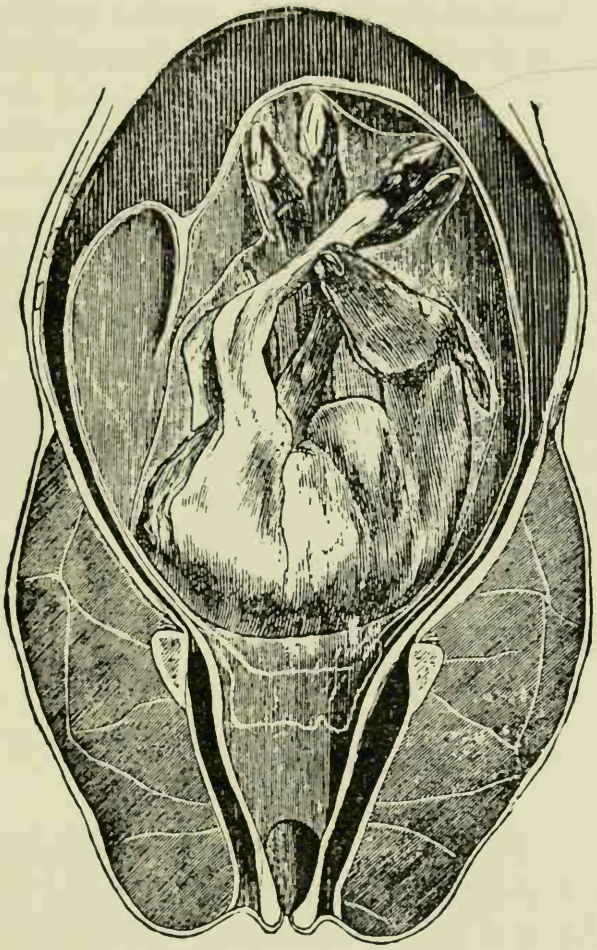

Fig. 110.—Transverse Presentation: Right Cephalo-Ilial Position—Upper View. (Franck.)

The direction of the long axis of the fœtus varies: it may be nearly horizontal, and head directed towards the right or left flank (right or left cephalo-ilial position); or less commonly the fœtus is vertical, and looks as if seated on the udder of the mother, the head being directed forwards, the mane towards the sacro-lumbar region of the dam.

When such cases are attended to early enough, the mother may be saved, and frequently the offspring of the cow and goat. The favourable issue is due to the fact that the presentation does not admit of the fœtus entering the pelvic inlet, and the obstetrist, though he may have to contend with the paralyzing and fatiguing uterine contractions, has not to overcome the wedging of the fœtus in the pelvic canal. In the mare, because of the energetic uterine contractions, it is often difficult to change the position of the young animal.

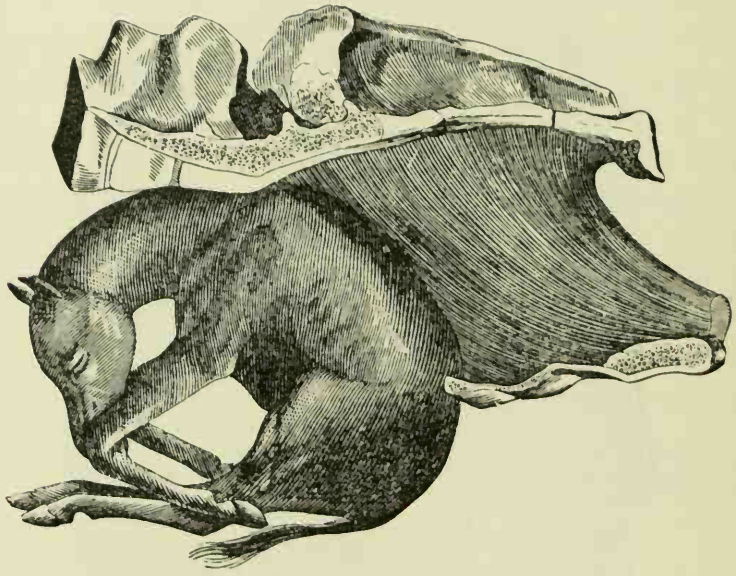

FIG. 111.—TRANSVERSE PRESENTATION: VERTICAL OR CEPHALO-SACRAL POSITION. (SAINT-CYR.)

Indication.—The principal indication in such cases is to convert the dorsal into an anterior or posterior presentation. Pelvic version as a rule is the most advantageous, because the hind-limbs only require to be dealt with, whereas in anterior version there is the head in addition to the fore-limbs. Emollient fluids should first be injected into the uterus, and the hind-quarters of the mother raised. Retropulsion must then be practised. The fœtus must be pushed by hand or repeller forwards into the uterus, rather obliquely, and in a direction the opposite to that of the part we wish to bring before the inlet.

The retropulsion and injection, together with the uterine

contractions and the efforts of the fœtus, if alive, have frequently the effect of making the body glide around the inner surface of the uterus, until a convenient part presents. Then the fore-limbs and head, or the hind-limbs, according to the parts presented, are brought into the genital canal by the hand or by cords. If occasion demands it, rotation may be resorted to, in order to convert the vertebro-ilial position into the vertebro-sacral. Delivery is completed by moderate traction. The cephalo-sacral position is not so difficult to deal with as the horizontal lumbo-sacral, as it approaches the longitudinal presentation.

When these manœuvres fail, *embryotomy* must be practised. The vertebræ should be divided at the presenting part, the lumbar region commonly, and the entire body cut through at this division ; then evisceration is carried out, and each half of the body is extracted in the best and easiest manner possible. The anterior half may be placed in the anterior presentation and removed, the posterior half removed by traction with cords and hooks attached to the loins and pelvis, or by changing to the posterior presentation.

Cæsarian section may be employed as a last resort, particularly in the smaller animals. In these, version is often effected by means of forceps and external abdominal manipulation.

SECTION II.—DYSTOKIA FROM THE STERNO-ABDOMINAL PRESENTATION.

The sterno-abdominal presentation is a rather common one, particularly in the mare. The fœtus has the sterno-abdominal region and crossed limbs, either flexed or extended, presenting at the inlet or engaged in the passage, while the dorsal region is towards the fundus of the uterus. Sometimes the fœtus is horizontal in position, lying on one side, and the head directed towards the right or left flank (right or left cephalo-ilial position) ; sometimes it is vertically placed, with the head directed upwards (cephalo-sacral position). The left cephalo-ilial position is, according to Saint-Cyr, much more frequent than the right.

The cephalo-sacral position is less common than the others.

Usually one or all of the limbs enter the genital canal, and even protrude from the vulva; occasionally they are doubled against the body, and retained in the uterus. The head is usually retained in the uterus, and is either turned backwards or placed above or below the body; when the latter, then it is either deformed or the neck is contracted (wryneck),

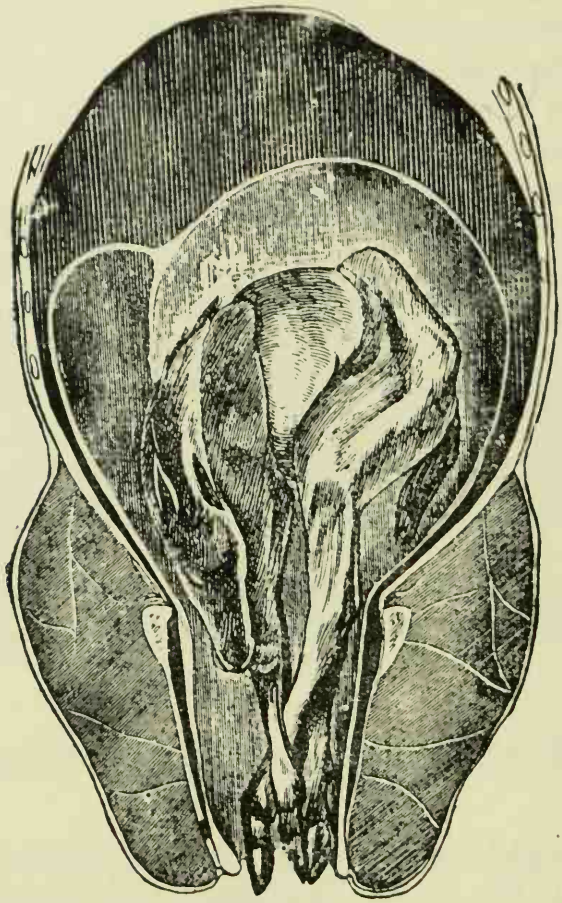

FIG. 112.—STERNO-ABDOMINAL PRESENTATION, HEAD AND FEET ENGAGED FOAL. (FRANCK.)

especially in the mare. If the limbs project equally, then the transverse presentation is direct; but if unequally protruded, the fœtus is lying obliquely. No progress is made with parturition in spite of the straining of the mother.

On vaginal examination, the limbs may be distinguished, and from their relationship the position of the fœtus may be made out. Sometimes the head can be reached, and this

gives the information necessary to decide what kind of version is most likely to be successful. Care must be taken to ascertain whether the limbs presented belong to one or more fœtuses or to a monstrosity. Sometimes it happens, especially in the mare, that the arm, extended into the uterus as far as possible, can touch only the belly and sternum of the fœtus, and at the side the elbows and stifles, because of the curvature of the fœtus and the bending of the limbs and neck in different directions.

In the cow, owing to the wider abdomen and shorter fœtus, this difficulty in manipulation does not usually arise.

Prognosis.—When the limbs can be reached, this presentation is not as a rule so troublesome as the dorso-lumbar. It is at the same time one of the most difficult and serious the obstetrist can meet with.

Indications.—In order to effect delivery, the presentation must be modified, and it is often most convenient to resort to posterior version, and bring the hind-limbs into the genital canal. The hind-limbs must be secured and corded at the pasterns. Should the head or fore-limbs be in the passage, they must be pushed back into the uterus, while traction is made on the hind-limbs. In order to prevent the hind-quarters jamming against the maternal ilium in dealing with the cephalo-ilial position, the traction on the hind-limbs should be oblique. Then by rotation the position is converted into the lumbo-sacral, and delivery completed.

Retropulsion is comparatively easy when there is plenty of room and the straining is not very severe; but in the mare it is often the opposite, and it is very dangerous to push the fore-limbs into the uterus. In that case, as the foal almost constantly dies, embryotomy should be resorted to.

The anterior limbs must be amputated at the knee, elbow, or shoulder, according to the farther point which can be conveniently reached. Then the fore part of the fœtus is thrust forward into the uterus, while the hind-limbs, which are corded, are drawn towards the pelvic inlet.

In those not infrequent cases in which the fœtus has its limbs doubled against the body, and can only be touched with the tips of the fingers, the hind-quarters of the mother should be lowered by placing her on a sloping floor, and on

her back if necessary. This allows of the limbs being reached.

A *lateral* or *costal* presentation has been noticed by several writers. In this the fœtus, having the limbs doubled under the body, presents at the inlet by one of its sides, as it lies horizontally on its chest and abdomen. The limbs are more or less accessible to the operator, and therefore the mode of extraction is obvious after what has been said of the other transverse presentations.

CHAPTER VIII

OBSTETRICAL OPERATIONS

In the various malpresentations and malpositions, as well as for the other causes of dystokia already enumerated, the indications for rectification and extraction were alluded to and described at sufficient length, and the means to be adopted for carrying them out were likewise mentioned. It was shown that, in many cases, it is sufficient to correct the abnormal presentation or position, and rectify the deviation of limbs, neck, or head, to effect delivery in the ordinary manner by means of the hand alone. For, as has well been said, the practised hand is the best and most perfect of all instruments, and it can effect in obstetrical operations what no instrument is competent to achieve. Therefore it is that an operator with a long and powerful arm, and a small hand with strong fingers, possesses many advantages as an obstetrist, and is in a better position to afford relief than one with a short arm and large hand—especially in the correction of those deviations which are so frequent, and oftentimes so baffling.

Extraction by the hand alone may be effected in many cases of difficult parturition when these rectifications have been made; though even then it is essential that the os uteri be fully dilated, the vagina and vulva dilatable, and sufficiently prepared to allow the young creature to pass through; it is likewise necessary that such a relationship in proportions should exist between the volume of the fœtus and the capacity of the pelvis, that extraction can be accomplished without much difficulty. Finally, it is particularly desirable that the uterus retain its contractile power, and that its regular contractions should second the efforts of the operator.

In only too many cases of dystokia, however, one or more of these conditions are absent, and the unaided hand—no matter whether it be ever so well endowed and practised—fails to effect delivery ; so that, in order to overcome the difficulties, recourse must be had to various surgical instruments and appliances, and there must be performed, either on the mother or fœtus, more or less complicated and serious operations which demand strength, expertness, and an accurate knowledge of anatomy and physiology, and even of mechanics, in addition to a thorough acquaintance with surgical pathology. Some of the obstetrical operations have been alluded to; but it is necessary to study them as a whole, in order to master their special features, and particularly the manner in which they are to be performed, as upon the exactness of our knowledge with regard to them will generally depend their successful results.

These operations have for their object either to supplement the forces of Nature, which are insufficient to secure the birth of the young creature; to rectify its presentation or position; to diminish its size when it is either too large, too deformed, or too deviated or distorted, to pass through the maternal passages; to enlarge the latter, or to extract the fœtus by an artificial passage when these last do not admit of extraction. This leads to a consideration of: (1) *preliminary precautions and operations ;* (2) *rectification of presentations and positions of the fœtus ;* (3) *mechanical means for the extraction of the fœtus ;* (4) *embryotomy ;* (5) *vaginal hysterotomy ;* (6) *Cæsarian section ;* (7) *artificial premature birth ;* (8) *supplementary observations regarding mother and progeny.* In several of these the obstetrist requires the aid of assistants, who only too often have to be instructed in the part they are called upon to perform at the very moment their services are required.

Not only this, but far too frequently the veterinary surgeon is not called in sufficiently early, and the delay, and perchance the maltreatment to which the parturient animal has been subjected by unskilled attendants, has resulted in most serious complications, which the most competent assistants can afford little service in remedying.

PRELIMINARY PRECAUTIONS AND OPERATIONS.

A few observations may be made on certain precautions and operations which have to be attended to before any active measures are adopted in cases of dystokia. And first as to the animal which is to be handled.

With the larger creatures, and especially the mare, the position of the veterinary surgeon immediately behind the posterior limbs might be considered perilous, did we not know that the most irritable and vicious animals are generally rendered tractable by the parturient pains; and even the hand and arm introduced into the vagina, instead of provoking resentment, appear only to increase the expulsive straining. But it is sometimes necessary to have a strong assistant to hold up a fore-foot, in the case of the mare, while the hand is being passed into the genital canal. And while manipulation is going on it is advisable that the mare's head should be held by a person the animal is accustomed to; while a strong man on one side of the hind-quarters steadies this part with one hand and holds the tail aside with the other, and another on the opposite side also steadies the quarter with one hand, and the other hand pinches the loins when the mare attempts to strain or be restless.

But it sometimes happens that a twitch has to be applied to the nose, or side-lines or hopples put on the legs; for the mare is, as has been already remarked, very often a most troublesome and dangerous animal to deal with, and unsteady in the extreme. Not so the cow, which rarely requires any more constraint than a person holding the nose and horn; though it is advantageous to have a man on each side to act in the same manner as for the mare.

Obstetrical manipulations are usually effected while the larger animals are standing, and this is undoubtedly the most convenient position. But it not infrequently happens that the veterinary surgeon is called when the animal has been in labour for many hours, and perhaps been roughly handled by novices; so that, being exhausted, it has assumed the recumbent position, and is disinclined to get up. This is more especially the case with the cow, for the mare can

generally be induced to arise by mild persuasion; and it has been found that the sight of a dog will cause the first-named animal to start up when other means fail.

But it may be that the creature really cannot arise, or if it gets up it cannot stand; then the operator has to do as he best can while it is recumbent, and must kneel, or even assume the horizontal position. With regard to the animal itself, the lateral and ventral positions are very unfavourable, because of compression of the abdomen, which greatly hinders manipulation and interferes with delivery. Occasionally the animal may with advantage be placed on its back, and kept in that position by having previously had the feet brought together by means of a rope or hopples, and tying another rope to these by which assistants can steady the body; a truss of straw placed close on each side of the back will greatly aid in securing this position. In some cases it is most advantageous to have the front part of the body raised by litter, so as to bring the fœtus nearer the pelvic cavity; in other cases it may be equally advantageous to have the hind-quarters raised either by litter or by suspension, the hind-feet being fastened together by a rope, the end of which is passed over a beam and pulled until the required elevation is obtained. This raising of the hind-quarters has been successfully employed, in reducing torsion of the uterus; and it has been no less useful in cases of dystokia due to bending back of the head or neck of the fœtus.

Cases are met with now and again in which it is desirable to place the animal in the recumbent position, and then the greatest care is necessary to prevent its being injured in laying it down.

The cow has been placed on its side by passing a bed-sheet, folded lengthways two or three times, beneath the abdomen, in front of the udder, two men holding each end and lifting up as if to carry the animal off its feet; the cow immediately turns on its side and the hind-quarters fall softly on the litter, but the sheet must be kept tense. Another plan is almost as simple: A long rope is provided, with a noose at one end; this is passed around the horns, the rope is carried along the ridge of the neck, and a turn is made around the shoulders, another behind the shoulders, and a third around

the abdomen, the rope being then brought along the sacrum. A slow and steadily increasing pull is made upon it, and the animal soon bends the fore-legs, then the hind ones, and lies down in the most gentle manner.

Sheep and pigs are generally recumbent, and the operator has to kneel; but they are more easily handled than the cow or mare.

Dogs and cats are also readily managed, and can be placed upon a bench or table, and moved about to any position required without restraint.

When about to deal with a case of dystokia, the practitioner has, of course, first ascertained its history, and satisfied himself as to the general condition of the animal before commencing his exploration. With the larger animals it is necessary that he divest himself of some of his upper garments—how many will depend upon the nature of the case; it may suffice to remove the coat and vest, and roll up the shirt-sleeves, or it may demand removal of everything save under-vest and trousers; indeed, for such cases it is well to be provided with a waterproof sleeveless overall or a long sleeveless blouse, fastened round the waist by means of a band, and a pair of waterproof trousers. Strict attention should always be paid to surgical cleanliness in all the manipulations connected with delivery.

Before introducing the hand and arm into the genital canal, they should be covered with oil or an antiseptic lubricant, *e.g.*, a solution of lysol, in order not only to facilitate their introduction, but to protect the operator against septic infection. It is very fortunate for him if he can use both hands alike, as the left hand is sometimes more convenient than the right, and in tedious operations the one relieves the other. The fingers are brought together in cone shape, and pushed into the vulva gently, then into the vagina, with a slight rotatory motion, while the animal is not straining; should it strain, the hand must not be pushed on, but wait until the animal is again quiet. In this way the vagina is explored, and if necessary the hand is carried into the uterus, should there be no obstruction. A careful exploration makes the practitioner acquainted with the state of affairs—the condition of the genital canal and the presentation and position of the fœtus,

if the membranes are ruptured, as they nearly always are—and allows a diagnosis to be formed, from which indications for treatment can be arrived at.

It should not be necessary to add that all this procedure—much of which has also to be observed in cases of maternal dystokia—ought to be carried out carefully and methodically, and without undue haste; and to accomplish it satisfactorily a perfect knowledge of the obstetrical anatomy of both mother and fœtus—familiar to the hand no less than to the mind—is of the greatest value.

Mention has already been made of the necessity for employing some bland emollient fluid with which to lubricate the genital canal when this has become dry, as, owing to the "waters" having escaped for some time, the uterus is applied close to the fœtus, which may have made some progress towards expulsion, and much manipulation may have already taken place before the arrival of the practitioner. Any oily or mucilaginous fluid will answer the purpose, but perhaps the best of all is what is known as "linseed tea" or "linseed jelly." When there is not time to prepare this, it has been found very serviceable to inject first a few ounces of oil, then tepid water, and, finally, another quantity of oil. The chief thing to be observed is to inject a sufficiency—say two or three gallons for the larger females, and from a few ounces to a pint for the smaller.

If the manipulations are long continued, it may be necessary to repeat the injection, and for the cow or mare it is most advantageous to introduce a long piece of india-rubber tubing well into the uterus, and inject the fluid through this by putting the nozzle of the syringe into the outer end. When neither syringe nor tubing is available, a bottle may be used, and in this case raising the hind-quarters of the animal will facilitate the introduction of the lubricant. Lard may also be employed for the same purpose. It has the advantage of being solid and hence more easily applied to parts which may most require lubrication.

With the smaller animals much benefit is often derived from immersing the hind-quarters, or even the whole of the body, in warm water for some time, as this tends to relax the parts.

The expulsive efforts of parturient animals, and especially the mare, when violent, are generally a great hindrance to the operator in cases of dystokia, and sometimes prevent him from attaining success in delivery. To modify, or partially or completely suspend them for even a short period, may be of the greatest service; so that various measures have been resorted to in these cases—such as, for the mare, a twitch on the nose, and for the cow, pinching the nasal septum, pressing on the loins, or raising the hind-quarters. Causing the mare to walk on soft sloping ground or in a straw-yard, and not allowing it to stop, has been found to allay the pains for a sufficiently long period to allow what was required to be done.

The administration of narcotics, such as choral hydrate, is also frequently adopted with this object, and anæsthesia by chloroform has been found of great service with the mare. Partial unconsciousness will allay the excitement and abnormal straining, but will not suspend the uterine contractions. The anæsthetic should be inhaled until the introduction of the hand into the vagina or uterus no longer excites the severe straining. Partial narcosis might also be tried in some difficult cases of parturition in the cow, but then it must be remembered that in the event of slaughter the flesh will have the odour of the drug. With the smaller animals the production of this condition is often beneficial. A small dose of morphia may be used for this purpose in the bitch.

We will now consider the principal mutation movements required to effect a change in the position of the fœtus.

RECTIFICATION OF PRESENTATIONS AND POSITIONS OF THE FŒTUS.

We have seen how numerous and varied are the presentations and positions of the fœtus, and how, in order to effect delivery, some of these must be changed or modified; this can only be done by moving the fœtus itself, and so altering its relations to the adjacent parts of the mother. These movements are sometimes designated *mutations* by obstetrists,

and the procedure necessary to effect them varies with circumstances.

The principal of these mutation movements are four in number: *Retropulsion*, *Rotation*, *Version*, and *Extension* and *Flexion*.

In order, however, that these movements may be effected, certain conditions are necessary. In the first place, it is essential that the os uteri be sufficiently dilated, or relaxed and extensible, so that the hand may reach the interior of the uterus; next, the body of the fœtus must be movable in the uterus—a circumstance not always noted, as the organ is often contracted closely on the fœtus when the liquor amnii has escaped, or the fœtus itself may be fixed in the genital canal. And, finally, the fœtal envelopes must be ruptured, as it is impossible to manipulate the young creature effectively while it is entirely invested by them. It is essential also that the uterus and genital passage should be well lubricated before attempting these manipulations.

Retropulsion.

When the fœtus, in a vicious position, has entered the pelvic cavity and become fixed there, or even when in the uterus and approaching the inlet, before the position can be corrected it is nearly always necessary to push the creature forward again into the uterus, as there only, from the greater space this organ affords and the elasticity of its walls, can the impediment be overcome and adjustment effected.

"Retropulsion" is often necessary during protracted labour, even when the fœtus is in a good position, to enable the obstetrist to attach cords to the limbs or some part of the head or body.

In the anterior presentation, for instance, the fore-limbs have often to be pushed forward from the pelvic cavity, in order that the operator's arm may find room to search for and seize the head; or the latter has to be pushed into the uterus to allow the limbs to be felt for; and even in this presentation retropulsion of the hind-limbs may be necessary. This procedure may also have to be adopted in the posterior presentation when these limbs are flexed in the uterus, and the body has to be pressed forward as far as possible, so that

they may be extended and brought into the pelvic inlet; while it is also advantageous in transverse presentations when version has to be attempted.

This retropulsion is sometimes easy, at other times it is most difficult and laborious, and in certain cases it may even be altogether impossible.

The most favourable attitude for performing this operation, in the larger animals at least, is undoubtedly the standing one; but the body of the animal should not be perfectly horizontal, for a great advantage will be derived by raising the hind-quarters to a considerable degree, as we thereby throw the uterus and its contents forward, and away from the pelvic inlet. This elevation may be effected by straw or litter placed under the animal's hind-feet.

When the animal is recumbent and cannot be induced to rise, there is little, if anything, to be gained by raising and supporting it by means of slings or other appliances, as the pressure which these produce on the abdomen opposes the manœuvres we have mentioned. Not infrequently the sight of a strange dog, as has been mentioned, will cause the animal to get up.

When, however, the mare or cow is exhausted, and it would be injudicious or impossible to make it stand, then manipulation must be attempted in the recumbent posture. When this is decided upon, in many cases it will be found that a considerable advantage will be obtained by placing the animal on its back, propping it up in this position with trusses of straw placed on each side, and raising the croup by introducing another truss beneath the hind-quarters.

With regard to the smaller animals, such as the bitch, they can be placed on their back on a table, and an assistant will raise the pelvis as high as may be deemed necessary. Retropulsion of the fœtus may be effected with the hand in the large animals, the operator supporting himself firmly on his legs; but the arm must be strong, and very often it has to be engaged in the genital canal as high as the shoulder.

Seeing the difficulties attending this operation, and finding that the hand and arm are not always sufficient, veterinarians resort to a "crutch" or "repeller" (French, *repoussoir;* German, *Geburtskrücke*), in conjunction with the hand.

This instrument is of iron or steel, and is about three feet in length; it has a handle at one end, and a concave transverse piece, like the head of a crutch, at the other. This piece should be only about three or four inches long and may be either solid or jointed. Provided the latter is sufficiently strong

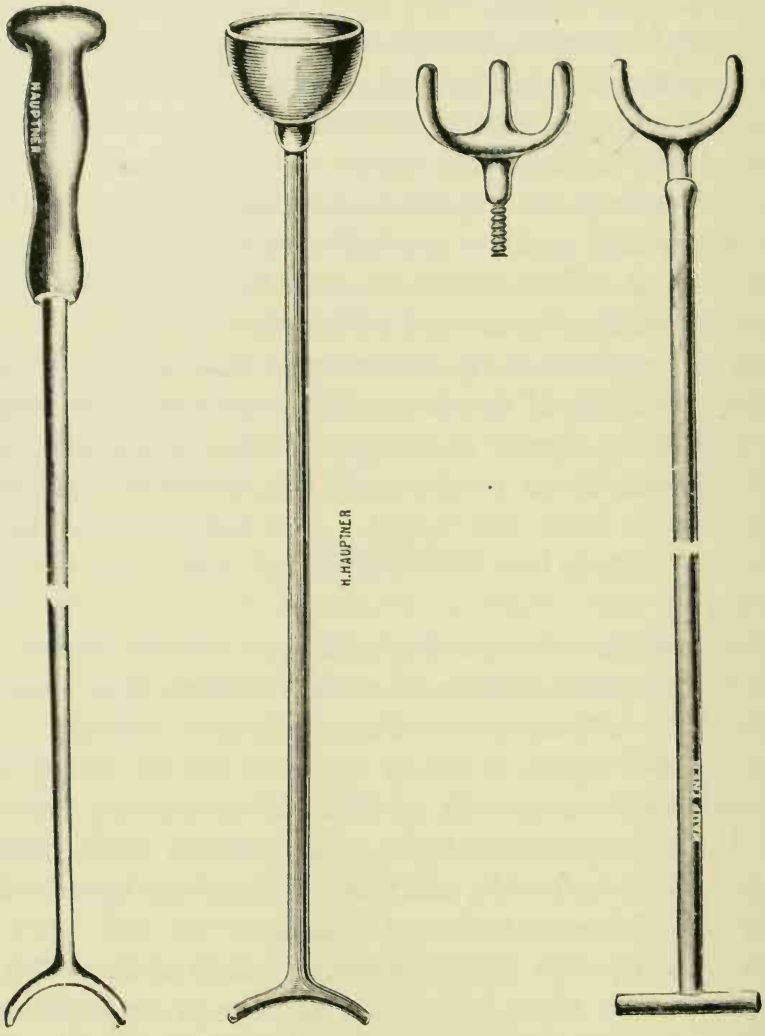

FIG. 113.—REPELLERS.

a, Gunther's repeller; *b*, Binz's repeller; *c*, Reindl's repeller (two and three pronged)

at the joints, it possesses advantages over the solid instrument, the principal of which is its easier introduction into the vagina and uterus. The crutch end, being carefully carried by one hand through the genital canal, towards the fœtus, is applied to the most convenient part of the latter; while the handle

is seized in the other hand, and propulsion effected either by this hand, the breast of the operator, or by an assistant.

This instrument is of very great service from the fact that it permits the displacement of the fœtus much farther forward than the hand alone can effect, and thus allows a wider space between the pelvic inlet and the body of the young creature; consequently, adjustment of the latter is more easily and promptly accomplished.

An assistant can maintain the body of the fœtus some distance from the pelvis by this instrument, while the hand of the operator is making the necessary rectifications; the latter is therefore much relieved, and to some extent he is also exempted from the difficulty and fatigue caused by the uterine contractions.

The ordinary repeller has some disadvantages, the greatest of which, perhaps, is its being inapplicable to certain regions of the fœtus which may chance to be in an oblique line to its direction—such as the head, limbs, etc. To remedy this defect, a short, pointed spike may be screwed into the middle of the crutch, opposite the handle, when necessary, and this effectually prevents its slipping; the part in contact with the fœtus, when provided with this tooth or spike, resembles a trident. While the instrument is being employed—all propulsion should only be made during the intervals between the pains—one hand of the operator must guide and maintain it against the fœtus, to prevent injury to the maternal organs.

In order to propel the head, Binz invented an instrument like a goblet, furnished with a long handle; the hollow portion fitted on the muzzle of the fœtus, and the head could then be pushed forward. Solid rods to be fixed to the limbs of the fœtus, in order to push them out of the way, have been proposed, but their utility is questionable.

It must not be forgotten that, after all, the hand is the safest and most perfect of instruments, and should always be preferred—at least at first—to such appliances as we have described. For it *feels* the parts on which it is placed; it adapts itself more exactly to the surfaces with which it comes in contact; it perceives the resistance they offer, and warns the operator as to the amount of force necessary to effect a certain object; whereas the presence of a hard and rigid

instrument increases the uterine contractions, and, however well adapted it may be, it may suddenly glide off rounded and slippery surfaces, and cause serious injury.

Nevertheless there often are occasions when the hand cannot accomplish what is necessary in the way of retropulsion, and it is then that the repeller may be most useful; it will generally be found quite safe when employed by a careful and experienced operator.

The spasmodic contraction of the uterus, especially during the labour pains, is a great obstacle to every kind of manipulation in the interior of the organ; the way to subdue them has been referred to.

Retropulsion, as we have said, should only be effected in the intervals between the "pains"; though during these the expulsive efforts should be resisted, so that what has been accomplished may not be lost. The propulsion should be done by *jerks*, which are far more effective than a continuous push, and they are not productive of any inconvenience.

It is nearly always necessary to secure some part of the fœtus which is to be repelled (head or limbs) by cords, so that it may be readily seized again and brought into the pelvic cavity. This will be alluded to presently.

Rotation.

"Rotation" of the fœtus consists in turning it more or less round its longitudinal axis, with the view of changing the relation between the presenting parts and the maternal pelvis, or modifying the *position* without interfering with the *presentation*. It is required occasionally in all the domestic female animals, and most frequently in the cow, when the greatest diameter of the fœtus is presented to the smaller diameter of the pelvic cavity, as in the majority of the lateral positions.

After pushing away the body of the fœtus—but not its limbs, if they are well placed—from the pelvic inlet, the hand and forearm are introduced in *supination* and well forward between the body of the young creature and the floor of the uterus; then the arm, resting on the pubis, is employed as a lever in raising and turning the part of the fœtus in hand to the right or left, as may be. If the young creature is alive,

this manœuvre is much more easily executed than when it is dead, as it seconds the effort. Boutrolle advises that the abdomen of the mother be raised by means of a girth or folded blanket, while rotation is being effected. Rainard recommends, when the limbs are in the pelvis, to tie them together, draw them beyond the vulva, put a piece of stick or any other convenient article between them, and to use this as a kind of lever to turn the body of the fœtus round to the necessary extent; or, which is preferable—as in the latter operation the limbs of the young animal may be seriously injured—to give the limbs to an assistant, who, acting under instructions from the operator, turns them one over the other in a kind of twisting and swinging manner, in the direction indicated by the operator, whose efforts are in this way greatly assisted.

The operation of rotation is completed when the greatest diameter of the fœtus is coincident with the sacro-pubic diameter of the pelvic inlet—a right or left vertebro-ilial position, for example, being transformed into a vertebro-sacral position.

This modification need not always be so complete, and it frequently suffices to convert a lateral position into an oblique one, by making the dorso-sternal diameter of the fœtus correspond to the oblique diameter of the inlet, measuring this from the supracotyloid crest of one side to the sacro-iliac articulation of the other. The same observation is applicable to posterior presentations.

Version.

"Version," or "turning," in veterinary obstetrics signifies effecting a *change of presentation*, or, in other words, bringing towards the inlet a part of the fœtus other than that which presented spontaneously, and thus correcting a faulty presentation.

A longitudinal presentation is that in which spontaneous birth can be alone effected; transverse presentations render birth impossible, and these, consequently, give rise to dystokia. Version is therefore indicated in all transverse presentations, no matter what region of the body may first offer at the pelvic inlet; it may even be required in certain forms of anterior or

posterior presentation ; and in all cases it is necessary to repel the presenting part, so as to bring one or other of the ends of the oval mass formed by the body of the fœtus to the pelvic inlet.

Hence we have two kinds of version : one which has for its object the movement of the head of the fœtus towards the pelvic inlet—*anterior* or *cephalic version ;* and the other the posterior part of the body to the same opening—*posterior* or *pelvic version*, corresponding to the *podalic version* in human obstetrics. Each of these versions has its advantages and disadvantages, according to circumstances ; though the majority of authorities prefer *pelvic version*, for the simple reason that with this there are only two appendages to care for—the hind-limbs, to which it is comparatively easy to give a good direction ; while in *cephalic version* there are not only the fore-limbs to attend to, but also the head and neck, the unfavourable direction of which may give rise to much trouble in delivery.

Version can only be effected in the uterine cavity, and when the uterus is entirely in the abdomen ; so if any portion of the fœtus has entered the inlet, retropulsion must be resorted to. Then the operation can be commenced. It is divided into two principal movements : *Repulsion* and *Evolution.*

Repulsion.—The hand—usually the right—being introduced into the uterus, reaches the presenting part of the fœtus, and by a succession of forcible pushes moves it away from the inlet—in fact propels it ; though this retropulsion should not be made directly forward, but *obliquely*, so as to press the region we desire to get rid of upward, downward, or to either side, according to circumstances. In this way, the opposite parts glide over the uterine walls, previously lubricated ; they move round towards the hand, and are more easily reached.

Evolution.—When the parts which are sought for reach the hand, they are firmly seized by the operator and drawn towards him. The uterine contractions assist in this operation, the version movement is continued, the fœtus becomes lengthened, as it were, and unfolded, and when its larger diameter is brought into the axis of the pelvis the manœuvre is completed.

Version is not always successful when first attempted ;

indeed, it has often to be relinquished and again tried, until successful, notwithstanding the fatigue and demands on patience these repeated efforts entail.

Complete version is required in the transverse position of the fœtus, and is generally difficult; it, and indeed all degrees of turning, and all vicious positions of the fœtus, demands that the first thing to be done is to secure the most useful parts which present—as the limbs or head—by cords or other appliances, so as to be able to find and utilize them again if circumstances require that they should be used to assist in delivery. Very frequently traction on one or more of these cords, and the manipulations of a hand in the uterus, will greatly facilitate turning.

As in so many other obstetrical operations, undue haste and violence are to be guarded against in these mutations, and gentleness, patience, and perseverance, should be observed. We not infrequently find that, when the presentation is anterior or posterior, and the limbs are in a favourable direction, though the body of the fœtus may be somewhat inclined to the right or left, the uterine contractions are sufficient to effect adjustment, gradual and well-directed traction being alone required from the operator.

Extension and Flexion.

Independently of the *general mutations* which have for their object the movement of the whole mass of the fœtus in the uterus, it is sometimes only required to resort to *partial mutations*, as in the adjustment of one or more of the limbs, head, neck, etc., these consisting of *extension*—as when the arm is extended on the shoulder, the forearm on the arm, the head on the neck, the latter on the trunk, etc., and *flexion*, in bending the various articulations—as those of the limbs, in order to place them or the body in a better direction; and *rotation*. In all these manœuvres a rudimentary knowledge of mechanics will be of great advantage, and especially that pertaining to levers, which is particularly applicable to manipulations of the limbs that so frequently prove of the greatest service in obstetrical operations.

It only too often happens that the arm of the obstetrist is found to be sadly too short in version and other manœuvres,

and these are consequently rendered more difficult of accomplishment. With regard to this, the obstetrist should always employ the arm corresponding to the side of the fœtus on which the limb, the part sought for or to be manipulated, is situated. For instance, if the fœtus is in the anterior presentation and dorso-sacral position, with the head bent round towards the left flank, or the left fore-limb (right hind-limb in a posterior presentation) doubled under the body, he will use his right arm; but the left will be employed in the opposite conditions. By doing so, the operator gains in length of arm, particularly towards the shoulder, and can consequently reach deeper into the uterus.

Flexion and extension of a limb are often made simultaneously, and it sometimes happens that, in extending such a part as the head to straighten it, it effects its own rotation. Extension alone serves to bring the limbs from under the chest or abdomen; flexion is rarely resorted to, and chiefly when it is desired to return an extended limb again into the uterus. In these operations on the limbs, when the weight of the fœtus is an obstacle, the body of the creature is inclined to the side opposite to that of the limb to be manipulated; thus, if the right limb is flexed under the body, and we desire to extend it, the fœtus is inclined from right to left, so that, the right side being raised, the limb can be taken from under it. The body is turned in the way indicated for *rotation*.

We have casually alluded to the attitude of the larger animals during version, retropulsion, and rotation, and pointed out the advantage to be derived from elevating the hind-quarters, by placing litter under the hind-feet. And we have also remarked that it is not always possible to obtain the desired attitude, but that these manœuvres must sometimes be performed when the animal is recumbent. It may even happen that it will be advantageous to place the animal in a recumbent position. Leconte strongly recommends laying it on its sternum, and flexing the fore and hind limbs under the body, as in this attitude the uterine cavity can be more easily explored, and the necessary alterations made in the position of the fœtus, the operator lying extended behind the animal. Some obstetrists place the animal on the right or left side, the operator lying on either of his sides, according to the arm he intends to use.

Throwing down an animal for this purpose is always, however, to be avoided if possible; and if it is already down, the animal should either be placed on its sternum or compelled to get up. When the uterus is lying very low in the abdomen, should the latter be extremely pendulous, or when the fœtus—as in the cow—is fixed beneath the brim of the pelvis, it may be found very advantageous to place the parturient creature on its back.

As for the operator, he must conform his attitude to that of his patient. We have already written on this point when treating of parturition, and we have nothing to add. If the animal is standing and the hind-quarters are raised, and particularly if the obstetrist is not tall, and more especially if the patient is a mare, the plan adopted with much success by Dickens may be followed. This consists in placing the animal, if the case is likely to be protracted, under an open shed, tying the head to the manger or rack, and supporting the body by two sacks passed under the belly and attached to ropes which pass over a beam above. A partition on the right side, to prevent swerving, is preferred, the assistant being placed on the left side. Immediately behind the animal is put a strong four-legged wooden cow-crib, which serves many purposes. Firstly, it prevents the mare backing; secondly, the operator standing in it, is perfectly safe from injury during his manipulations, while it gives him a great advantage in the elevation it affords, especially with tall animals; thirdly, it forms a convenient stage whereon to place cords, instruments, medicinal agents, etc.

We will briefly notice some of the occasions when these movements have to be effected, though reference may have been made to one or two of them already.

Extension or Straightening of the Head and Neck.—This is resorted to when these are not in a proper direction, and the fœtus must always be pushed into the abdomen in order to carry out the operation.

The *head may be flexed at the occiput*, so that the chin is applied to the lower border of the neck, and if it has not entered the pelvis and can be moved somewhat, extension is easily effected by passing the hand into the cavity, insinuating it between the pubis and the forehead of the fœtus until the

nose is in the hollow palm, with the fingers if possible under the chin, or the thumb in the mouth and the fingers in the intermaxillary space ; then it is lifted sideways above the margin of the pubis, when it can be brought straight into the genital canal by gentle traction.

When the neck has entered the pelvic inlet, then it is imperative that it be pushed into the abdominal cavity ; before this is attempted, however, cords should be passed round the fore-feet (though these are not to be pulled at first), and another around the neck of the lower jaw or the under-part of the head ; this cord the operator holds in one hand or gives to an assistant, while he presses the neck forwards and to one side, raising the nose by means of the cord and hand when there is sufficient room.

An exaggerated and more difficult form of this condition is the *head and neck flexed beneath the chest*, but it can be remedied if the labour has not been protracted. The lower jaw should first be corded, the cord being pulled by an assistant while the operator pushes the body back until the head is somewhat relieved, when the propulsion ceases, and the hand seizes the lower part of the head and raises it and the forehead ; and so, pushing away the body and guiding the head alternately, the latter is brought into the canal. When, however, the practitioner is not called in—which is usually the case—until after the waters have escaped some time, attempts have been made at delivery by amateurs, the genital passage is dry, and the uterus is applied close on the fœtus, then adjustment of the head and neck is a serious affair, as the prolonged straining and pulling have put the head farther beyond reach—pushed even beneath its abdomen ; so that the tips of the fingers can scarcely touch the nose, much less grasp it, while the contractions of the uterus, closely enveloping the fœtus, paralyze the arm, which has to be bent downwards in search of the head. In such a case retropulsion is futile, and the first thing to be done is to inject a large quantity of strained linseed-jelly, or some other mucilaginous fluid, into the uterine cavity, to compensate for the absence of the waters—unless it be decided to place the animal on its back, which is decidedly advantageous in this embarrassing case, when the injection should not be administered until the animal is cast. Having had the

passage well lubricated and the uterus separated from the fœtus, this may now have the fore-legs secured by cords, and the front part of the body pushed forwards, downwards, or sideways, so as to reach the head, which may be seized by the ears, orbits, or lips, until the neck of the lower jaw can be grasped and corded, when, with steady manipulation and traction, the head and neck can be adjusted. Pulling at the limbs, then pushing the body forwards, so as to effect displacement of some kind, will often assist the operator when the head is beyond his hand. Such cases in the mare are nearly always impossible to rectify, and even in the cow they are most formidable, and not always satisfactory in their termination.

When the head is bent upwards and backwards (the opposite condition to the last), somewhat similar measures must be adopted. The fore-limbs should be corded, as well as the neck of the lower jaw if it can be reached. Then the body is to be pushed away from the brim of the pelvis, employing mucilaginous injections, if necessary, before attempting this, and by means of the hand in the uterus and alternate traction on the head-cord and retropulsion the fœtus can generally be got into a proper position for delivery.

A somewhat frequent misdirection is *the head bent round to one side*, extending to the shoulder, or even as far as the chest or flank. When only slightly inclined to one side, reposition is easily effected by seizing the lower part of the head, raising it upwards and bringing it round to the genital canal. It must not be forgotten that the hand employed to bring the head round must correspond to the side on which it lies; for instance, if the head is bent to the right, then the left hand must be used to manipulate with.

When the head is even as far back as the elbow, it may often be brought straight by first cording the fore-limbs, then reaching the neck of the lower jaw over the shoulder, and cording that also; retropulsion and manipulation, with traction in the intervals of the straining, will effect the rest. The case is very different, however, when the head is carried as far back as the flank or hind-quarter, and especially if the uterus is contracted on the fœtus, and the interior is dry and adhesive. In the mare this is always a most formidable affair to deal

with. Here the mucilaginous and emollient injections are indispensable, and should be at once resorted to. Then the fore-limbs must be corded, and pushed into the uterus if they are in the way (using a porte-cord if necessary), the hand passed along the convexity of the neck, and between it and the uterine wall, until the lower jaw is seized and corded. Pressure is now made on the breast of the fœtus, so as to push it away from the pelvic brim and towards the side of the uterus opposite to that on which the head lies, so as to bring this nearer to the inlet. Then the hand turns the lower jaw upwards by placing the fingers in the submaxillary space, and pulling the head round by means of the cord, the hand in the uterus keeping the body away from the pelvis and to the opposite side, as well as protecting the uterus from injury by the incisors. If there is a tendency to twisting of the neck, this must be overcome by manipulation of the head, which must be brought gradually and carefully round.

But it only too frequently happens that the hand cannot reach the head, or can only touch the ear-tips, and then the difficulty is very great—it may even be insurmountable. Various plans have been tried, such as exciting the fœtus to move if it be alive; raising the abdomen of the mother, elevating the front part of the body or placing her in the dorsal position; or implanting hooks in the fœtal orbits. But there is no certainty in any or all of these methods, and the only one which has hitherto been most successfully employed is that introduced by Delafoy. Having satisfied himself as to the state of affairs, he passed the end of a strong rope, about 12 feet long, with a knot at the end to prevent it slipping from his hand, between the neck and chest of the fœtus; this end he passed downwards, seized it at the lower side of the neck, and brought it out of the vaginal canal, so that the middle of the cord was inside the bend in the neck. Again introducing his hand into the uterus, he pushed the loop of cord by the tips of his fingers as near to the head as possible, when he directed an assistant who held the two ends to twist them round and round each other, until the cord was quite tight around the part on which it was placed; at the same time his hand prevented any of the placenta or cotyledons from getting into

the twists. This having been accomplished, the hand was placed on the breast or one of the shoulders of the fœtus, and while he pushed it towards the fundus of the uterus the assistant exercised steady traction on the cord. In this way, by good management, the head was brought towards the cervix uteri, where it was immediately accessible, and could be placed in its normal position. A small weight of any kind attached to the end of the cord, instead of the knot, would carry it more readily between the neck and shoulder or chest, and the porte-cord might also be used to pass the cord if the hand could not be extended sufficiently far.

Extension of the Limbs.—The limbs are not infrequently a cause of difficulty in parturition, and have to be adjusted before delivery can be effected. The difficulty is usually due to their being flexed at the knees or hocks, or completely retained in the uterus.

With regard to the *fore-limbs,* their adjustment is more difficult in the mare than the cow, in consequence of the different segments of the leg being longer.

When *flexed at the knees,* if they have entered the genital canal or are at the entrance to the pelvic inlet, they must be pushed forward into the uterus before they can be extended, and it may be advantageous to cord the lower jaw or head previous to this being attempted. Then the forearm is brought into a horizontal position, if it was not so before, the shank is seized and smartly extended on it, its lower end being adducted and the knee directed upwards and outwards, so that the pastern is opposite the inlet; the hand is now passed to the fetlock and hoof, which is held in the palm, the pastern-joints are well flexed, the lower part of the limb is pulled into the genital canal, and the whole extended there. With the calf, flexion of the phalanges is not so necessary, as they are shorter than those of the foal, and they may be immediately extended; but the hoofs should be covered by the hand to prevent laceration of the genital mucous membrane.

The other limb is adjusted in the same way, if it be at fault, and the head is then brought into the inlet by means of the cord and the guidance of the hand.

Should retropulsion be rendered very difficult because of the condition of the uterus, injection of mucilaginous fluid

must be given, the limbs corded at the pasterns or shanks, and an assistant pull on these cords while the operator raises the knees upwards and outwards, at the same time pushing them forwards; this manipulation is alternated with attempts to bring the phalanges into the inlet by the hand, and straightening them there, at the same time guarding the maternal mucous membrane from damage by the hoofs.

When the *fore-limbs are completely retained*, the head or lower jaw is first corded, then steadily pushed forward towards the fundus of the uterus; if the forearm can be grasped, it is flexed, so as to bring the knee upwards, and—provided parturition has not long commenced—the lower part of the limb can be extended in the canal. But if the forearm cannot be firmly seized, so as to alter its direction, a cord must be passed between the leg and the body—as with the head doubled back on the side—the two ends being twisted outside and held by an assistant, while the loop around the forearm is brought as near to the knee as possible by the hand. Then the upper part of the leg and the body are pushed forward by pressure on the point of the shoulder, while the assistant pulls steadily on the cord until the knee is in the pelvic cavity, when the limb is extended in the manner just described.

With regard to the *hind-limbs*, the same remark applies as to the greater difficulty in adjusting them in the foal than the calf, in consequence of their greater length; and as they are proportionately longer than the fore-limbs, while the movements of the principal joints are so interdependent that one cannot be bent without influencing the others, their rectification is much more troublesome and laborious.

When the hocks present in a flexed state in the mare, it is generally considered hopeless to attempt extension, especially as the fœtus is nearly always dead; therefore it is advisable, in order to spare the mare pain and exhaustion, to divide the gastrocnemii tendons, and so straighten the limbs.

With the cow the case is not so serious, and the calf may be delivered alive. Retropulsion of the hind-quarters and hocks is absolutely necessary; this can be effected by persistent effort and the exercise of patience, the pushing forward being done by jerks in the intervals of straining, until the fœtus has been removed some distance from the brim of the

pelvis. Raising the hind-quarters of the cow is very serviceable in this measure. Then the tibia is placed in a horizontal direction, the pastern or shank is corded, as with the fore-limb, and the hock being kept as far away as possible from the inlet, and towards the maternal flank, the lower part of the leg is carried backwards by cord and hand until it is in the canal. In doing this the operator uses the point of the calcis to push the hock, the body of the fœtus being kept obliquely, and care being taken that the points of the hocks do not damage the uterus, by covering them with the palm of the hand—a procedure which must also be adopted with the hoofs.

When the hind-limbs are retained in the maternal abdominal cavity of the mare, the case is quite as serious as when the hocks present; but in the cow it is not so formidable, and a similar procedure must be adopted as in the hock presentation. The body of the fœtus is propelled forward as far as possible, and the tibia is flexed on the femur, so as to bring the hocks up towards the inlet; this is not very difficult if the fœtus can be readily moved, for the hand can be then passed to the stifle and the limb drawn towards the pelvic cavity, when, seizing the tibia, this is flexed on the thigh. A cord may be passed round the thigh and brought down to the hock, or as near it as possible, in particularly difficult cases; and in propelling the buttocks into the uterine cavity the assistant steadily pulls the cord, the hand of the operator not only pushing, but also guiding the direction of the lower part of the limb and preventing injury to the uterus, until the hock has reached the inlet, when the leg should be extended in the manner before described. In this difficult and fatiguing operation, a repeller used by a second assistant will be found most valuable.

MECHANICAL MEANS FOR THE EXTRACTION OF THE FŒTUS.

Mechanical means for the extraction of the fœtus are required when the expulsive efforts of the parent, and perhaps the hand of the obstetrist, are insufficient to produce delivery. These means are employed to effect change in the position of

the fœtus, or to apply force sufficient to overcome the resistance offered by the obstacle to birth; they comprise a number of articles, the chief of which are *cords* and *bands*, *halters*, *crotchets* or *hooks*, and *forceps* of various kinds. The uses and advantages of these we will now notice. But before doing this, we must again point out the great advantage, should the "waters" have escaped, and the genital canal and interior of the uterus be dry and tenacious, of moistening these parts well before resorting to mechanical operations.

Cords and Bands.

Cords and bands are, of all mechanical means, the most useful in veterinary obstetricy in the large animals. They have the additional advantage that they are readily procurable, are cheap, very portable, and can be employed where and when other means are inapplicable. Owing to their pliability, they can be pulled in any direction desirable, without much danger of injury to the maternal organs. In all cases of difficult parturition, it is an axiom with the experienced veterinary obstetrist that the first thing to be done is to cord the presenting limbs; or if they do not present, to seek for and cord them as soon as possible. When this is done, then they may be returned to the uterus, or put out of the way, as the cords will always bring them to hand again when required. While they are admirably adapted for exercising traction upon the fœtus, they may also in certain cases be of great utility in changing a malposition.

They are used with the view of applying traction to the fœtus, and they can be attached to the head, body, limbs, or tail, according to circumstances. The limbs are more particularly the parts upon which they can he most usefully employed, because of the length and solidity of these, the facility with which they can be seized, and the prominences of the joints and hoofs, which prevent the cords from slipping. For the foal, they are most advantageously fastened around the pastern, but with the calf above the fetlock-joint is better. The head cannot be so advantageously "corded," though it is a most important region of the body to secure in certain cases; the neck of the lower jaw affords a fairly good hold,

and if the fœtus is alive the cord, made into a halter, can be put over the head. For the jaw the cord should be rather thin and soft, but strong. The neck can be corded, as can also the loins and croup, as already shown. In embryotomy cords are also of great service, as they can be fixed to parts of the body, and even to shreds of skin, to aid in removal.

The cords vary in thickness and length; they are usually about five or six feet long, and, if spun rope, from a quarter to half an inch or more thick. At one end may be a small loop or iron ring, by which to form a running noose.

Manilla hemp, and web or leather bands are resorted to in order to prevent damage to the fœtus during traction—the cords, from their hardness, thinness, and strands, being liable to cut. But this accident need not be much feared, and the durability, convenience, and other advantages possessed by the cords, are greatly in their favour. They retain their hold better than anything else, and particularly if they have only a simple loop at the end, instead of an iron ring.

If it is desired to render a hard cord softer, it may be partially untwisted at the part intended to go round the tissues of the fœtus.

Some practitioners have cords ready prepared, which they use for a long time; but unless precautions are adopted they may become a source of danger, as they readily absorb septic matter. They should therefore be thoroughly cleansed after each operation, and disinfected or boiled; or, best of all, new cords used on each occasion.

When running knots or loops are made, these should be so tied that there is no chance of their becoming untied through slipping, when they come in contact with lubricating fluids and are strained.

Whatever is used for this purpose should be very pliable, and yet sufficiently strong to withstand energetic pulling. A very good pattern consists merely of a cord with a running noose at one end, and a small piece of round wood at the other, to give the assistant a better hold and enable him to use more force (Fig. 115).

When cords are employed on the limbs, they are generally applied to the pasterns of the foal, as these parts are most accessible and afford the most secure hold. They can also be

applied above the knees and hocks, when it is necessary to amputate the limbs at these joints. The head may be secured around the lower jaw, but it is sometimes better to pass the noose into the mouth and around the top of the head, like a gag-rope.

When the cords are to be applied to the limbs, either of two modes can be resorted to with this object. If the limb is bent, it must be extended and brought opposite the inlet, or into the genital canal, as the case may be. Then the fingers are gathered together and slightly bent, so as to form a kind

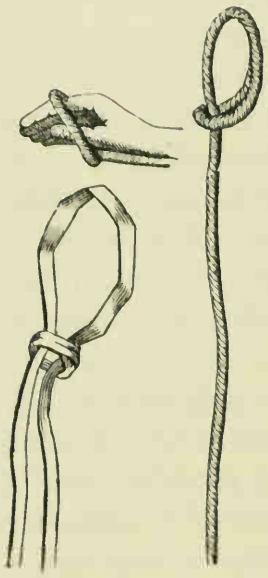

FIG. 114. — TRACTION CORD AND BAND, AND THE MANNER OF APPLYING THEM. (BAUMEISTER)

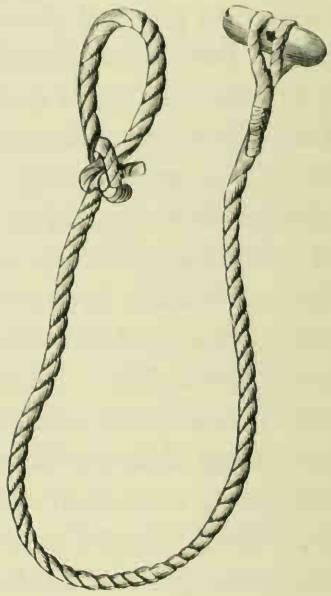

FIG. 115. —SCHAACK'S TRACTION CORD. (SAINT-CYR.)

of cone, on which the running noose of the cord—sufficiently wide to pass over the foot of the fœtus—is placed, as in Fig. 114. The noose is kept in its place on the fingers, in tightening the cord, by the free portion which passes along the under-side of the hand and arm; unless this precaution is adopted, the noose will be pushed back over the hand when introduced into the vagina, and cannot easily be got forward again. The hand and cord, being oiled, are introduced into the passage, and when the foot is reached it is seized in the fingers; these are then suddenly bent, so as to shorten the cone and cause the noose to run on to the pastern

by a gentle pull of the cord, which can then be tightened and given to an assistant.

The other method, which is Schaack's, and by some obstetrists considered preferable to that just described, consists in placing the middle of the noose on the dorsal aspect of the ends of the two middle fingers, the finger on each side holding it against these, while the thumb keeps it in the palm of the hand. The left hand maintains the cord sufficiently tense to assist in keeping the noose on the hand; and if the part of the cord which runs through the loop is placed towards the thumb, the latter can readily increase the size of the noose. The hand is passed into the vagina sideways, the little finger downwards, and when the foot is reached the thumb and index-finger are placed within the noose, which they enlarge in separating from each other; while the remaining fingers, flexing on the hand, are passed around the foot, and cause the noose to glide over the hoof on to the pastern. The fingers now press on the loop, while the other hand, drawing at the cord outside the vulva, tightens the noose around the limb.

When the limb is flexed and cannot be extended, as at the knee or hock, the looped cord may be employed, though a long cord, doubled, will be found to answer very well. This is passed round the flexure, the doubled end pulled to the vulva, and the other end passed through the loop; this done, the loop may be tightened, passed up to the elbow or stifle, or down to the pastern.

The lower jaw is "corded" in a similar manner; the mouth of the fœtus being opened, the noose is passed around the neck of the jaw, and the knot or loop placed beneath the chin.

In embryotomy cords render good service, as they can be attached to any part within reach; after decapitation of the fœtus, for instance, a cord passed through a thick fold of the skin on the upper part of the neck affords an excellent means of traction.

When long cords are used, and energetic traction is likely to be employed, it will be found convenient to have knots at intervals, to prevent the hands of the assistants slipping.

Halter, Head-Cord, or Head-Collar.

In addition to the limbs and other parts, we have stated that the traction cord can often be advantageously applied to the lower jaw. Indeed, in the anterior presentation, even when the fore-limbs are "corded" and the head is in a favourable position, it will generally be found very useful to apply traction to the head in addition, as not infrequently pulling at the fore-limbs alone only fixes them more firmly in the passage.

We have also mentioned that the interdental space, or "neck" of the lower jaw, is the most convenient for the attachment of the cord; but nevertheless it will be found in practice that this does not afford nearly so firm a hold as the limbs, and that if the noose does not slip off the jaw, which is often the case, should the traction be at all energetic the bones will probably be smashed, the fœtus, if alive, irreparably damaged, and an important accessory means to extraction lost; besides, traction on this part throws the head too much upwards. Should the head be turned back towards the side, cording the neck does not reduce the deviation, but only allows it to be brought in a doubled condition into the genital canal.

It is therefore most important that means be at hand to secure the head firmly and solidly, either with a view to correct deviation when this part is in malposition, or to exercise traction upon it when it is adjusted, and when the fœtus remains immovable by pulling at the fore-limbs.

We have suggested that the noose of the cord, sufficiently widened, instead of being placed on the lower jaw, should be first passed into the mouth of the fœtus, then carried up over the head and behind the ears, the loop of the noose remaining, of course, tightly drawn in the mouth, as this must be the direction from which the traction is exercised; if pulled at from behind the ears, the noose would be drawn off. In placing the noose in this position, the straight porte-cord— will be found very useful.

Instead of this simple noose, which can readily be made when needed, various kinds of head-stall have been proposed by veterinary obstetrists from time to time, and some of these

possess certain advantages. Binz proposed a kind of head-collar, or halter, which could be adapted to different-sized heads (Fig. 116). It is made from a long piece of cord with a loop or eyelet at one end, and at a certain distance from this—from 14 to 16 inches—a second loop. The other end of the cord is passed through the first loop, so as to make a noose which goes round the neck of the fœtus; then through the second loop, which goes round the lower part of the head, and may be made large or small. The remaining portion is used

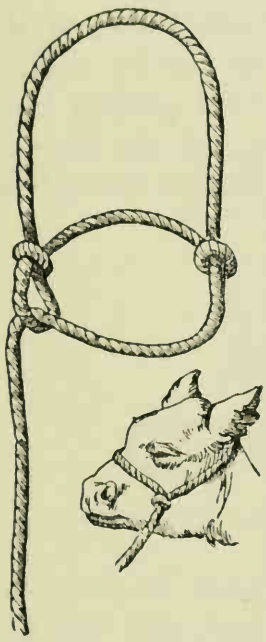

FIG. 116.—BINZ'S SIMPLE HEAD-COLLAR. (BAUMEISTER.)

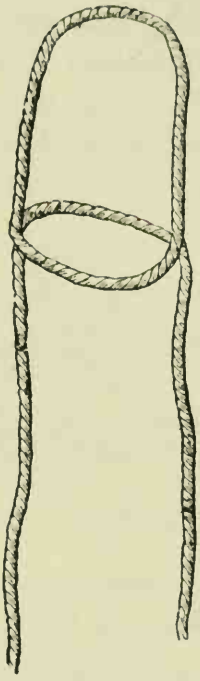

FIG. 117.—RUEFF'S HEAD-COLLAR: NO. 1. (RUEFF.)

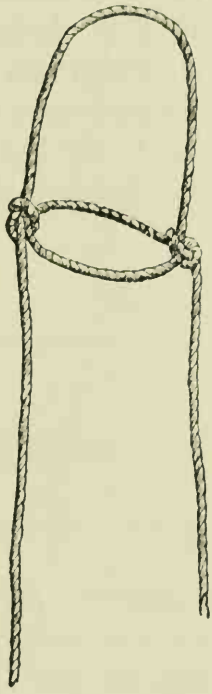

FIG. 118.—RUEFF'S HEAD-COLLAR: NO. 2. (RUEFF.)

for traction. This improvised halter is held at its upper part by the index-finger and thumb, passed into the genital canal or uterus, where it is placed on the head of the fœtus and the sides applied to the cheeks; the lower portion, which was open, is now closed by running the end of the cord through the second loop, by which the head is firmly secured, as in Fig. 116.

Instead of having the first loop at the end of the cord, Baumeister and Rueff make it nearly in the middle, with the second loop at the same distance as in the other halter. This

allows of two cords—one on each side of the head—to pull at (Figs. 117, 118)

Binz has devised a special head-apparatus (Fig. 119), to which he has given the name of "forceps-band" (*Zangenband*). This is a band of flax, silk, or some other woven material, which is at its widest part about 4 inches broad, and in length about 6 or 7 feet. At one end is a moderately large opening, while the other is divided into two portions to within some distance from the loop; these last pass through a round, movable, cork-shaped piece of wood, metal, or leather. The head of the fœtus is passed between the divided ends of this band, which are then tightened behind the jaw by running the keeper close up to the chin, the undivided portion being brought over the forehead towards the nose, and the divisions passed through the loop. In this way the head is firmly held,

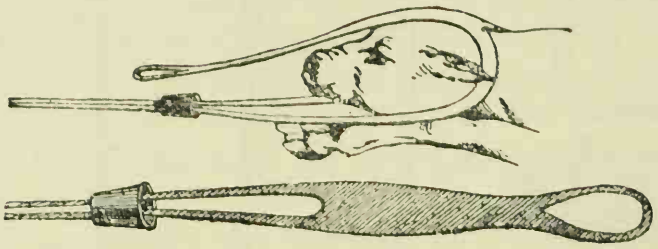

FIG. 119.—BINZ'S FORCEPS BAND. (BAUMEISTER AND RUEFF.)

and powerful and direct traction can be made on the head, above and below, by means of the upper part with the hole at the end, and the two portions beneath. It has been found particularly useful in cases of hydrocephalus.

Schaack, in 1848, introduced another kind of head apparatus, which he designated a "sliding head-stall" (*têtière à coulant*), but which is perhaps better known in France as a "forceps halter" (*licol-forceps*), by reason of its shape and use. It is composed of two doubled cords, one of which (Fig. 120, 1, 1) forms the *head-stall*, while the other (3, 3) makes the nose-band. The two are united by a metallic runner (5), which allows the apparatus to be increased or diminished in size at will. The *runner*, which forms the key of the apparatus, is a piece of brass or pewter a little more than an inch in length, about an inch in breadth, and half an inch in thickness. It is perforated by three holes, two of

which are parallel and pass through the wider part of the metal, while the third, placed between them, runs through its narrower surface. The two ends of the head-stall loop go through the parallel holes, the cord composing this being nine or ten feet long and one-third of an inch thick, the loop itself being intended to lie behind the ears of the fœtus. One side of the loop is fixed in the runner, by rings of waxed packthread above and below the hole, this waxed thread being also run up on the loop, to give it a certain degree of rigidity.

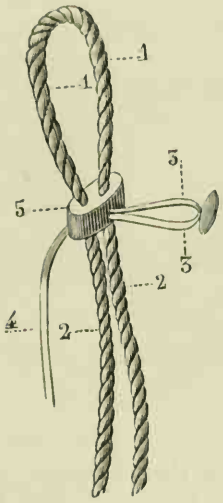

FIG. 120.—SCHAACK'S FORCEPS HALTER. (SAINT-CYR.)

1, 1, Head-stall; 2, 2, two cords, its continuation; 3, 3, nose-band; 4, single cord, forming a continuation of the loop constituting the nose-band; 5, metal runner, uniting the several parts of the halter.

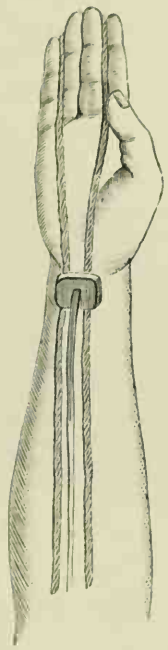

FIG. 121.—MANNER OF PLACING SCHAACK'S HALTER. (SAINT-CYR.)

The other half of the cord is freely movable in its hole in the runner, and a knot tied near its end allows it to be distinguished from the fixed half. The *nose-band* (3, 3) is made of two strong but soft strips of leather sewn one within the other, and doubled in the middle to constitute a loop 8 to 10 inches long, the two portions being made into a single cord (4) between 3 and 4 feet long, and which passes through the single hole across the runner. The middle part of the nose-

loop has a kind of shield or button of thin leather, to prevent the loop slipping through the hole.

This was the apparatus first devised by Schaack, but recently he has somewhat modified and simplified it by dispensing with the nose-band altogether, as he found that the nose of the fœtus could be better guided and held by the hand. Experience has proved that this simplification allows the halter to be more easily applied.

The manner in which the original halter was employed is described as follows: The head of the fœtus being in front of the inlet and readily accessible to the hand, the nose-loop is

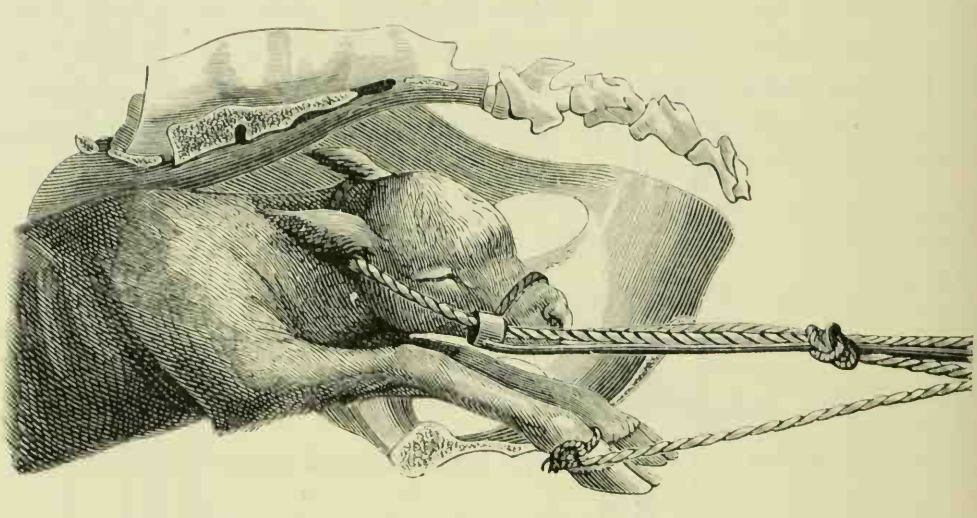

FIG. 122.—SCHAACK'S HALTER PLACED ON A CALF'S HEAD, THE RIGHT FORE-PASTERN BEING ALSO CORDED. (SAINT-CYR.)

pulled through the runner until stopped by the leather button, while the head-stall loop is made sufficiently wide. The middle of the latter is placed at the end of the second and third fingers, the movable part of the cord being between the middle and index finger, the fixed side between the ring and little finger (Fig. 121). The apparatus is at first held by the index and middle fingers against the other fingers, as well as by the thumb, which keeps both cords in the palm of the hand; and finally by the left hand, which, drawing lightly on the three cords, keeps them sufficiently tight. The runner should be at the wrist, the button of the nose-loop towards the hand.

The apparatus being so disposed, the hand is introduced sideways (little finger downwards) into the vagina, until it

arrives at the head of the fœtus; then the nose of the latter is passed into the head-stall loop, which is pushed forward by one side of the face—say the right—towards the neck and over the ear, the other half being now carried on the opposite side towards the left ear, and then the runner is seized below the jaw. In this way the hand has passed round the length of the head-stall from its fixed to its movable part, the latter readily allowing the loop to enlarge and pass over the salient portions of the head, the loop being nevertheless kept sufficiently tense by the right hand pushing the runner up towards the throat: while the left hand, pulling at the movable cord—recognized by the knot at its end—tightens it as much as may be necessary. The nose-loop is placed by introducing the index-finger of the right hand under the button, and drawing the loop through the runner to a sufficient length, the left hand keeping the other two cords tight; the end of the nose is passed into the loop, which is lifted as high as need be. This done, the right hand is withdrawn from the uterus and vagina, along, while keeping tight, the three cords. These are tied together in a knot outside the vulva, and the head is thus securely and solidly fixed.

Saint-Cyr and others highly recommend this apparatus, which in its modified form differs but little from that described by Binz some years previously. He remarks that its extreme simplicity, its trifling cost, the facility with which it can be placed after a little practice, its solidity, which enables it to withstand any amount of traction, and its absolute innocuousness, all combine to render it one of the best and most precious instruments required in veterinary obstetricy. In the first place, when it is properly applied it cannot slip, and all the amount of force necessary under the circumstances may be employed without fear; next, being formed of small and flexible cords, which are well oiled before use, it cannot injure the maternal organs in any way; thirdly, from the manner in which it acts on the neck, the lower jaw, and the face, and the impossibility of its becoming tighter when once it is fixed, it is absolutely inoffensive, so far as the fœtus is concerned; and, finally, owing to the nose-loop, it always keeps the head in a good direction, prevents it from deviating, and compels it to follow the course most favourable for its extraction.

Schaack's halter is more especially applicable to the bovine fœtus, the head of which is so much larger and squarer than that of solipeds, and sometimes requires very energetic pulling to remove it from the pelvis.

It is not always an easy task, however, to place anything like a formed halter over the head, especially if this is in the genital canal, so that it has been found more convenient to make the halter on the head. Detroye takes a cord about 10 feet long, in the middle of which he makes a simple knot—a check-knot; this is passed by the hand or porte-cord around the neck behind the head, and the knot withdrawn to the vulva; a loop or running-knot is made on the cord at a

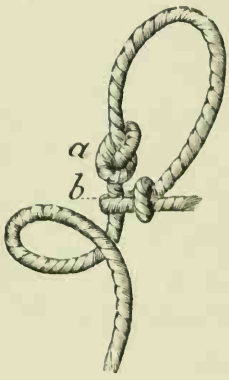

FIG. 123.—HALTER WITH A SINGLE TRACTION CORD. (DETROYE.)

a, Check-knot; *b*, running-knot or loop.

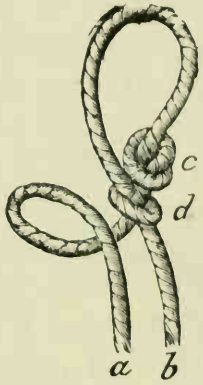

FIG. 124.—HALTER WITH TWO TRACTION CORDS. (DETROYE.)

a, *b*, Two ends of the cord; *c*, check knot on the *a* portion; *d*, running-knot or loop on the *b* portion.

certain distance from the check-knot, and the shorter portion of the cord is passed through it, the loop being tightened and run up until it is close to the knot (Fig. 124). The length of cord between the two knots should be sufficient to encircle the upper part of the neck, and form a kind of halter without the nose portion; the loop may be made previously, when it is possible to make it glide on the head. After drawing the portion with the check-knot on it sufficiently tight to place the head-piece in its proper situation, the same portion should be passed or hitched round the lower end of the head; the knots ought to lie between the branches of the lower jaw. If it is desired to have only one traction cord, the running-knot

or loop should be made at one end, and the check-knot a calculated distance from it (Fig. 116).

This forms a very simple and solid apparatus for exercising any amount of traction on the head, without much risk of danger to the fœtus.

A still simpler method consists in passing the middle of a ten or twelve foot cord behind the ears of the fœtus, carrying the sides down behind the lower jaw, and then twisting them outside the vulva until the two ends form one portion between the branches of the jaw. This, however, has rather a tendency in some cases to tilt the nose too much upwards.

With the smaller animals, cords cannot be passed around the head of the fœtus in the same manner as in the mare or cow, because of the want of space; and on the same grounds forceps are objectionable. For anatomical reasons, it is essential that the traction force should be applied behind the head, as if the sum of the expulsive efforts were directed there. With this object, Defays devised an apparatus which fulfils this indication, and is very simple and easily applied. It consists merely of two very pliable copper or brass wires—twisted picture-frame wire will answer admirably—about 16 inches in length, and looped in the middle, so as to be applied to the fœtus in the following manner: The first finger of the left hand, being passed into the vagina, serves to guide one of the loops towards the summit of and behind the fœtal head; and it then conducts the loop of the other wire beneath the head behind the jaw. This done, the two wires on each side are twisted by a little machine (Fig. 125) composed

Fig. 125.—Defays' Wire Extractor with the Torsion Rods.

of a thin iron rod in a handle, the other end of which is thickened and pierced by holes running nearly parallel to the stalk. Into these holes the two wires of one side are passed; the machine on each side is pulled up as close as possible to the head of the fœtus, and then, each being turned round three or four times, the neck is enclosed in a kind of noose or collar formed by the two wires (Fig. 126).

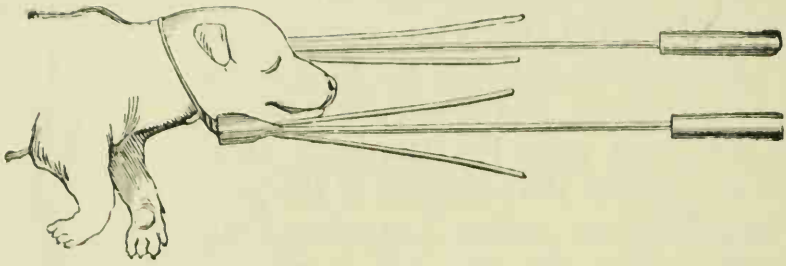

FIG. 126.—DEFAYS' WIRE EXTRACTOR APPLIED.

The rods are now withdrawn from the latter, and the fœtus can be extracted by exercising traction on the ends of the four wires outside the vulva. By this contrivance, delivery is effected without injury to the bitch, and, unless it is much decomposed, without separating the head of the fœtus.

A much simpler, readier, and perhaps more successful apparatus is that devised by Breulet, of Marche, Belgium,

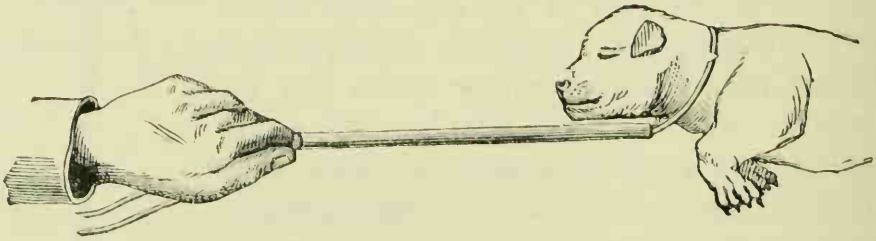

FIG. 127.—BREULET'S NOOSE FIXED ON THE FŒTUS.

which is very useful in the accouchement of small bitches, and might be successfully employed with sows, ewes, and goats. This apparatus is the same in principle as Defays' wire extractor, but there is only one wire. The principal part of the invention is a noose-tube, consisting of a tubular piece of round wood, from 4 to 6 inches long and $\frac{1}{2}$ inch thick. The wire may either be of copper, brass, or iron (catgut may be used for the same purpose), about 16 inches long; this is

doubled, passed through the tube to a certain extent, so as to form a loop or noose at the end. When it is to be used, the first finger of the left hand carries the loop into the vagina of the bitch, and slips it behind the occiput of the puppy; then the two ends of the wire are passed through the tube, and this is pushed into the vagina under the chin of the fœtus; the operator now tightens and secures the wire by giving it a turn round the first finger of his right hand, placing his thumb at the end of the tube (Fig. 127). A little traction then extracts the fœtus, and without doing it or the bitch the least damage. This instrument is exceedingly useful in canine obstetricy, even with the tiniest toy terriers, and may be employed to extract the puppies alive.

Pass- or Porte-Cords

When treating of certain presentations, it was remarked that, though the use of cords is urgently indicated in some cases, the arm is not sufficiently long to pass them to the region where they might be most effectively fixed; while the energetic uterine contractions paralyze the hand of the operator, and often prevent it manipulating accessible parts which it is desirable to secure by these means. In such circumstances the *porte-cord* or *pass-cord*, which has been sometimes referred to, is of great service. The instrument is of two shapes—*straight* and *curved*.

The *straight porte-cord* is usually a rod of three-eighths of an inch iron, furnished with a wooden handle at one end, and an eyelet or double opening at the other to receive the cord.

The *curved porte-cord* has the end through which the cord passes more or less bent, and in certain cases it is more useful than the straight one, from which it only differs in having this curvature.

Different forms of these instruments have been described, but in principle they are all really the same.

The straight one can be used to pass the traction cord around the limbs, or the neck of the lower jaw, and may act with the cord in pulling these towards the vulva; or, if properly constructed, it may also be most serviceable as a repeller in pushing them forward into the uterus. A very

good and simple pass-cord of this kind is that introduced by Darreau (Fig. 128 A, B), which can be employed as a retractor and repeller. Two of these may be used at the same time on two limbs. For instance, in the sterno-abdominal presentation,

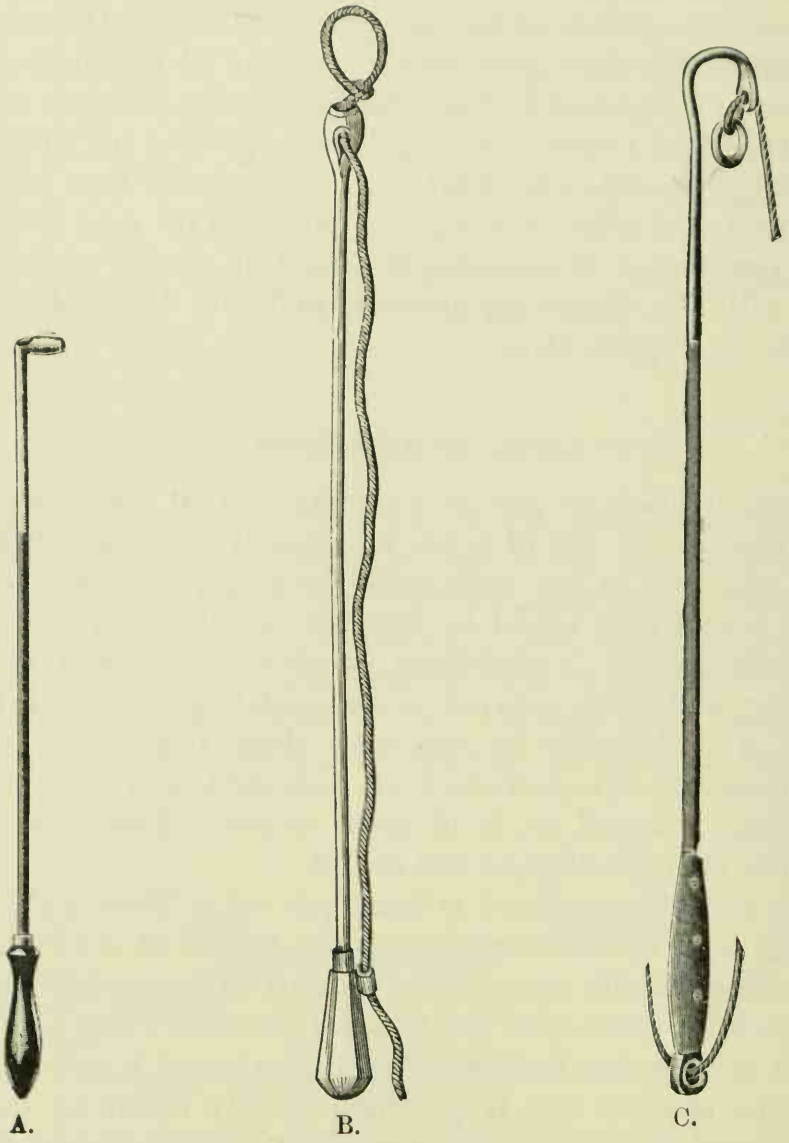

FIG. 128.—PORTE-CORDS, DARREAU'S PATTERNS.

when posterior version is decided on, the hind-limbs are corded in the usual way; then this repeller, armed with a noosed cord of sufficient length, is introduced, the noose passed on to the pastern or knee of one fore-limb, and the cord drawn tight and fastened around the handle. Another

pass-cord is attached in the same manner to the other fore-limb, so that each instrument becomes a solid fixture to the leg, and is confided to an assistant. The operator then pushes back the fore-limbs as far as possible by hand, while each assistant seconds his efforts with the repellers. When all has been conveniently adjusted, traction is made on the hind-limbs, the repellers being still employed to overcome the resistance of the fœtus and follow its movements.

The curved pass-cord has its uses in certain cases when the straight one cannot be serviceable—as in passing a cord round the head or bent neck, thigh, or loins; there are also several patterns of this instrument, but if the straight one is made of iron, it may be bent sufficiently to answer the purpose in the case of flexed limbs or bent neck. An ordinary walking-stick with a crook handle may, on an emergency, be made to serve this purpose by making one or two holes in the handle for the reception of the cord. Or when this cannot be procured, an excellent substitute will be found in a piece of iron or lead attached to the end of the traction cord, the weight of which greatly facilitates the passage of the cord around the straight or bent neck, hocks, or knees.

Tyvaert has for a long time made profitable use of a simple porte-cord. This is composed of a somewhat short piece of iron wire, about the thickness of a goose-quill, and bent a little round, the length and curve varying with the part to be secured. One end is turned to form a small ring, while the other is bent to make a hook a little longer than wide. A cord being attached to the ring end, the wire is passed round the part it is sought to seize; the hook end remains free, and afterwards receives the traction cord, serving to form a running noose on the part. This porte-cord is very simple, and may be made on the spot when required; it has proved most useful for securing the neck or hocks.

Binz's pass-cord (Fig. 129) is much used in Germany. It is sufficiently large to pass round the doubled neck of the fœtus, while its shortness allows it to be easily manipulated in the uterus. It is from 12 to 16 inches long, and made of wood or iron; at the bent end is an opening through which the cord passes. The instrument (named a *Geburtssonde* by

the Germans) is passed to the middle of the cord, and may then be introduced into the uterus, where, from its curvature and its shortness, it can be pushed behind or between the limbs, in the double of a bent neck, etc. The hand seeks the half of the cord on the opposite side of the part, and pulls it into the vagina; the instrument is then withdrawn, and the part is ready to be pulled at by the cord left encircling it.

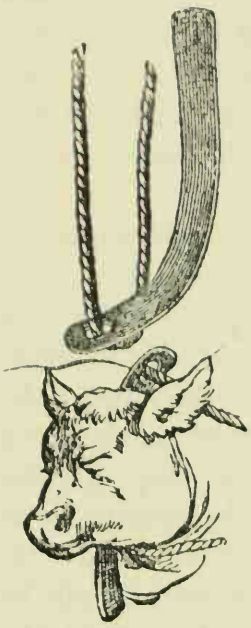

FIG. 129.—BINZ'S PORTE-CORD.

The ordinary curved pass-cord is introduced into the genital canal in the same manner as the other form, but with only a loop or ring (no noose) at the end of the cord; the curved portion is pushed around the part to be secured, and the hand, leaving it, is passed to the opposite side of the part, where it searches for the loop or ring, which, when found, is drawn into the genital canal. The instrument is then withdrawn, the cord remaining around the part; the free end of the cord is passed through the loop or ring, and being pulled at, the limb, neck, body, or whatever it may be, is secured in the noose so formed, and traction can in this way be directly exerted upon it.

Crotchets or Hooks.

Obstetrical *crotchets* or *hooks* are iron or steel instruments of variable dimensions, more or less curved at one end, which is blunt, sharp, or pointed, the other end having a ring or eyelet if short, a handle if long. The latter is from 30 to 36 inches in length (including the handle), and acts directly on the fœtus without any other appliance intervening; while the short hooks have cords attached to them, or they may fit on the finger of the operator by means of a ring. Some sharp crotchets are jointed at the end curve, so as to permit them to be more readily and safely introduced into the genital passage by bringing the sharp point near the stalk, the curve being restored by a spring when the fœtus is

reached. But the advantages of the jointed hooks are very few, while their strength is impaired and their expense increased. In using the long or short pointed crotchets, risk of injury to the maternal organs may be obviated, if the hand is not found sufficient to guard the instrument during its introduction, by fixing the point in a piece of cork or soft wood, to which a long piece of twine is attached; when the crotchet is required to be implanted in the fœtus, this shield may be removed from the point, and withdrawn from the genital organs by pulling at the end of the twine outside the vulva.

Blunt and sharp crotchets are much employed in veterinary obstetrics, and are very valuable. The blunt crotchets are more particularly resorted to when the fœtus is alive, and it

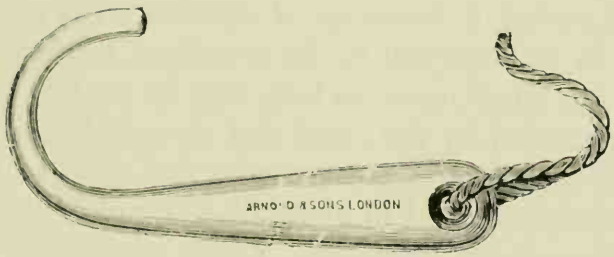

FIG. 130.—SHORT BLUNT CROTCHET.

is hoped to extract it before it is dead; they are most serviceable in correcting deviations of the head or limbs, and the long crotchet is especially useful in finding and straightening the latter. The curve should be about 4 inches wide. The finger crotchet may be usefully employed when the hand is fatigued or paralyzed by the uterine contractions. Blunt crotchets of a much smaller size than those required for the larger animals can be most successfully employed in delivering the sow, sheep, goat, bitch, or cat. In the bitch a small hook, shaped like a buttonhook, is often of exceedingly great service in removing a puppy in dystokia. Frequently the operator can use it successfully in the smaller dogs, in which forceps cannot be applied.

With the sharp crotchet, the curve should certainly not be very wide; the smaller it is, the more readily it can be passed into the genital passage, and the less chance of injury is there to the mother or operator; it should not be greater than

the hand can cover. At the same time, if the curve is too small, the crotchet does not obtain sufficient hold of the fœtus, is readily torn out, and for this reason may be most dangerous. The point should be so bent as to readily penetrate the part in which it is determined to fix it, and the

Fig. 131.—Short Blunt Crotchet, Hinged.

angle of the curvature should be such that the more the crotchet is pulled at, the deeper and more firmly the point will enter.

There is rather a diversity of opinion with regard to the preference to be accorded to the crotchets, some practitioners preferring the short ones, as they can be readily carried into the uterus guarded by the hand and moved about there, so as to be implanted in the most convenient part of the fœtus, while the cords attached to them allow traction to be made in the most favourable direction. Other obstetrists prefer the

Fig. 132.—Short Sharp Crotchet, with Round Point.

long rigid crotchet, which they affirm is more easily placed, one hand guiding the point through the passage, the other hand acting on the handle.

These preferences depend very much upon whether the operator is more practised in the use of one or other of the crotchets, and also, doubtless, upon circumstances peculiar to each case requiring the employment of such instruments. Both long and short crotchets are most useful, and the obstetrist should have several of each, of various forms and dimensions, so as to be able to select that which is best adapted to meet the requirements of particular cases.

These instruments afford a simple and ready means of

getting hold of the fœtus in regions of its body which the hand cannot possibly reach, or, if it did, where it could do very little service either from the shape of the part, its

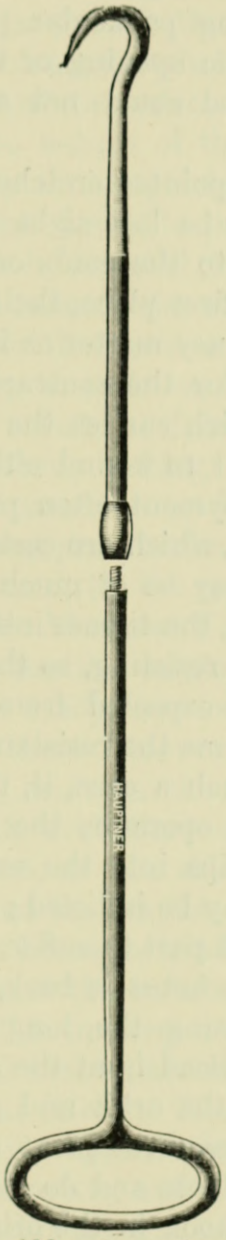

FIG. 133.—LONG POINTED CROTCHET FOR LARGE ANIMALS.

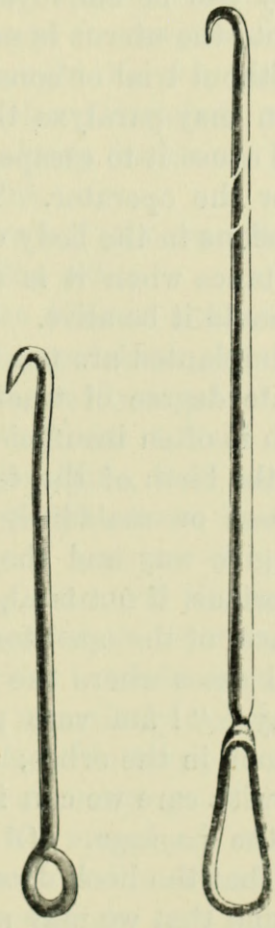

FIG. 134.—LONG POINTED CROTCHETS FOR SMALL ANIMALS.

slipperiness, or the paralyzing effect of the uterine contractions on the hand and arm of the operator. They can also be profitably employed in cases in which cords and

halters are useless; for not only will they serve in allowing traction to be made on parts which actually present at the inlet, but they can also be utilized in effecting those mutations which are necessary in order to bring particular parts of the young creature in front of the pelvic opening or through the genital canal, and which the hand could not seize or move.

It is no doubt true that the sharp or pointed crotchets have certain disadvantages which must not be lost sight of, and which lead to preference being given to the cords or halter when they can be employed. In the first place, their introduction into the uterus is not such an easy matter as it might appear without trial or consideration; for the contractions of this organ may paralyze the hand which carries the instrument and cause it to escape, or its point to wound either the mother or the operator. Their employment often produces serious lesions in the body of the fœtus, which are certainly of no importance when it is dead, but may be of much consequence should it be alive. Then, again, the tissues into which they are implanted are not very firm or resisting, so that only a moderate degree of traction can be expected from them, and which is often insufficient to overcome the resistance that prevents the birth of the fœtus. In such a case, if, through forgetfulness or maladroitness of the operator, the tissues suddenly give way and the crotchet slips into the maternal organs, serious, if not fatal, injuries may be inflicted; or the hand or arm of the operator may be the part to suffer.

"In all cases where the head of the fœtus is back," Cartwright says, "I am very partial to using the long sharp-pointed hook in the orbit; even if the head is at the *extreme* distance, with care we can insert it in the orbit and get the head in the passage. Of course, it requires great care in watching that the hook does not break loose and do mischief. I have found that we may pull by the hook in the orbit with great force, without tearing the skin of the calf, provided the latter is not in a decomposed state. From my experience, I can speak highly of the hooks; indeed, you cannot get the head up without them sometimes." And in embryotomy they may be most usefully resorted to for many purposes.

Reference will now be briefly made to the parts of the

fœtus upon which the crotchets can be most effectively employed, and the manner of employing them.

Parts into which the Crotchets may be implanted.—The parts into which the crotchets may be implanted are numerous; but those which are selected by the obstetrist will not only depend upon the nature of the malpresentation or malposition, but also upon the simplest indications for the adjustment of these. When the desirable part has been reached, the point of the crotchet is inserted in such a way that the instrument is directed towards the source of traction—the assistant. When blunt crotchets are employed, except in cavities, it will be necessary to make an incision through the skin before they can be inserted. Sometimes the sharp crotchets cannot be used without making these preliminary incisions, but then the instruments must be rather blunt.

The best parts for implantation are—(1) the *muscular tissues*, (2) the *head*, (3) the *spine*, and (4) the *pelvis*.

1. *The Muscular Tissues.*—These tissues are not advantageous for the employment of the crotchets; for although they are easily inserted, they are as easily torn out. Nevertheless these instruments, when fixed in certain muscular regions, such as the croup, thighs, loins, and neck—more especially the latter—may render useful service in rectifying deviations, as the skin offers a good amount of resistance. But, from the fragile and yielding nature of the textures, it must be borne in mind that the hand of the obstetrist should never leave the crotchet while traction is made on it, and that its position in them must be most attentively noted, in order to guard against accidents arising from its tearing away.

2. *The Head.*—The head offers many good points for implanting the crotchets—such as the symphysis of the lower jaw, the palate, and the orbit, as well as the ear and angle of the inferior maxilla on particular occasions.

It must be observed, however, that all these points are not of equal value. The *maxillary symphysis* is convenient, but not very firm; moderately strong traction will rupture it, and damage may then occur. Still, there are times and occasions when this part may be advantageously seized by the crotchet, which may be inserted in two ways: the point

of the instrument may be passed from below the chin into the mouth, or from the cavity of the latter, through the mucous membrane beneath the tongue, to below the chin. The first is generally preferable. When traction begins, the operator must be on the lookout for tearing away of the two branches of the jaw.

The orbital cavity is the best part of the head for a solid hold. Some authorities have expressed doubts as to the propriety of fixing a crotchet in the ocular cavity of a living fœtus, from a belief that the eyeball must be damaged, and Rainard goes so far as to advise that it should only be done when the creature is dead; though he adds that, if there is no other means of remedying a deviation of the head in the living calf, it is well to attempt it, "as it is better to have a living, if blind, calf, than a dead one with both its eyes intact.

But it is rare indeed that the eyes are seriously damaged by fixing the crotchet in their socket; and innumerable

FIG. 135.—SCHAACK'S CROTCHET.

instances testify that, if the fœtus is alive, the ocular globe is retracted to the bottom of the cavity when the instrument begins to be inserted, and so escapes injury. Schaack, who has freely resorted to this mode of adjusting the head or neck—in the sheep and goat more particularly (the smallness of the pelvis not allowing any other means to be employed)—describes his manner of operating as follows: "The crotchet I use," says he, "is a solid (or long) one; the point is blunt and slightly flattened (Fig. 135). When it is desired to pull at the head of the fœtal goat or lamb, the left hand at first seizes the nose, and the crotchet is fixed in the right orbit; with the right hand the other instrument is passed into the left orbit, the thumb of the left hand keeping the hook in the other orbit by pressing the stalk against the cheek. In this way I can pull with the two hands on both orbits, so as to keep the nose in a good direction." He has never seen the point of the crotchet cause the slightest injury to the globe of the

eye, although he has had, in the majority of cases, to pull very hard. The means has answered very well. And Cartwright states that "it is astonishing how wounds heal up in the cheek where hooks have been in the orbit. I have had two or three men pulling at the rod (of the crotchet), and the hook did not break out."

This immunity from injury in the case of the living fœtus does not, however, absolve the operator from exercising all due care in fixing and pulling at the crotchet. The inner aspect of the orbital cavity is the most favourable, and if the fœtus is alive, the blunt instrument must be first tried, the sharp-pointed one being kept in reserve until this has failed; or it may be used at first when the young creature is dead.

The *palatine arch* affords a very solid and useful hold for the crotchet, and many obstetrists have successfully utilized it in extracting the fœtus, some authorities—among them is Schaack—asserting that hooking this part is easier, and the results more certain and direct, than fixing the instrument in the orbit. The stalk of the crotchet is somewhat long; the hook end is passed sideways into the mouth of the fœtus, and over the tongue until it gets beyond the palate, when it is turned point upwards and seizes the base of the vomer. A very strong degree of traction can be made on this part without inconvenience to the young creature. It appears to be an excellent situation to plant the crotchet in the calf, particularly if it be dead, and it is desired to effect extraction as quickly as possible. It may be also employed in the foal, the only risk being more or less disunion of the palate, which may render sucking difficult or imperfect for a short time after birth.

Of course, the head must be in a good position either in the inlet or in the genital canal before the crotchet can be placed behind the palate. Traction must also be moderate and steady, and the usual precautions observed.

3. *The Spine.*—When embryotomy is practised or the fœtus is dead, the bodies of the vertebræ or their transverse processes, or the ribs, afford excellent hold for hooks, though care must be observed in placing them securely, and guarding them when they are being pulled at.

4. *The Pelvis.*—In posterior presentations, when cords cannot

be employed to the hind-limbs, the loins, or the croup, or when they have not sufficient power, then crotchets must be resorted to; and with this view the fœtal pelvis offers several very advantageous points. After removal of one or both hind-limbs, the *cotyloid cavities*, by their depth and the hardness of their walls, are admirably adapted for receiving the hooks and withstanding energetic pulling. If both limbs are amputated from the hip-joints, then a hook may be placed in each cavity; if ablation of only one limb has been effected, then one hook will be most useful.

The *pubic arch* and the *obturator foramina* of the pelvis are likewise well suited for crotchet traction in the posterior presentation when the fœtus is dead. In some cases the sharp-pointed crotchet may be passed directly through the rectum, and pushed forward so as to seize the border of the pubis, the margin of one of the oval foramina, the base of the sacrum, or the shaft of the ilium, care being taken that the point does not pass through the skin. Or the crotchet may be passed from without inwards—the safest method—after the pelvic bones have been denuded as much as possible of their soft tissues. This is, perhaps, the most practicable method if the hind-limbs have been already removed. But if they have not, then all the soft tissues of the fœtus—from the root of the tail to the ischial arch—should be largely incised, and the hand passed through the incision into the pelvis, to remove the viscera. The crotchet is then pushed into it, and planted either on the brim of the pubis or in the obturator foramen.

Crotchet-Forceps and Forceps

The introduction of forceps into human obstetricy marked a new era in the accoucheur's art, and has been productive of the greatest benefit in difficult cases of parturition in women. But they have not yielded much service to the veterinary obstetrist, except with the smaller animals; notwithstanding that Hurtrel d'Arboval, at the commencement of this century, asserted of the forceps that there are circumstances in which great advantages might be derived from them, and that their use is perhaps the best means of completing parturition when it cannot be terminated naturally. Attempts have been

arrives at the head of the fœtus; then the nose of the latter is passed into the head-stall loop, which is pushed forward by one side of the face—say the right—towards the neck and over the ear, the other half being now carried on the opposite side towards the left ear, and then the runner is seized below the jaw. In this way the hand has passed round the length of the head-stall from its fixed to its movable part, the latter readily allowing the loop to enlarge and pass over the salient portions of the head, the loop being nevertheless kept sufficiently tense by the right hand pushing the runner up towards the throat: while the left hand, pulling at the movable cord—recognized by the knot at its end—tightens it as much as may be necessary. The nose-loop is placed by introducing the index-finger of the right hand under the button, and drawing the loop through the runner to a sufficient length, the left hand keeping the other two cords tight; the end of the nose is passed into the loop, which is lifted as high as need be. This done, the right hand is withdrawn from the uterus and vagina, along, while keeping tight, the three cords. These are tied together in a knot outside the vulva, and the head is thus securely and solidly fixed.

Saint-Cyr and others highly recommend this apparatus, which in its modified form differs but little from that described by Binz some years previously. He remarks that its extreme simplicity, its trifling cost, the facility with which it can be placed after a little practice, its solidity, which enables it to withstand any amount of traction, and its absolute innocuousness, all combine to render it one of the best and most precious instruments required in veterinary obstetricy. In the first place, when it is properly applied it cannot slip, and all the amount of force necessary under the circumstances may be employed without fear; next, being formed of small and flexible cords, which are well oiled before use, it cannot injure the maternal organs in any way; thirdly, from the manner in which it acts on the neck, the lower jaw, and the face, and the impossibility of its becoming tighter when once it is fixed, it is absolutely inoffensive, so far as the fœtus is concerned; and, finally, owing to the nose-loop, it always keeps the head in a good direction, prevents it from deviating, and compels it to follow the course most favourable for its extraction.

Schaack's halter is more especially applicable to the bovine fœtus, the head of which is so much larger and squarer than that of solipeds, and sometimes requires very energetic pulling to remove it from the pelvis.

It is not always an easy task, however, to place anything like a formed halter over the head, especially if this is in the genital canal, so that it has been found more convenient to make the halter on the head. Detroye takes a cord about 10 feet long, in the middle of which he makes a simple knot—a check-knot; this is passed by the hand or porte-cord around the neck behind the head, and the knot withdrawn to the vulva; a loop or running-knot is made on the cord at a

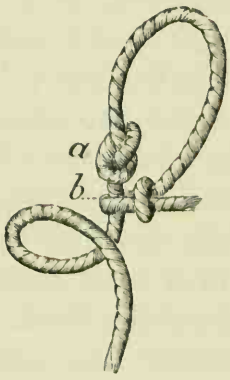

FIG. 123.—HALTER WITH A SINGLE TRACTION CORD. (DETROYE.)

a, Check-knot; *b*, running-knot or loop.

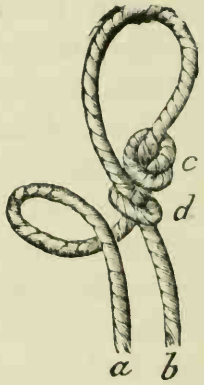

FIG. 124.—HALTER WITH TWO TRACTION CORDS. (DETROYE.)

a, *b*, Two ends of the cord; *c*, check knot on the *a* portion; *d*, running-knot or loop on the *b* portion.

certain distance from the check-knot, and the shorter portion of the cord is passed through it, the loop being tightened and run up until it is close to the knot (Fig. 124). The length of cord between the two knots should be sufficient to encircle the upper part of the neck, and form a kind of halter without the nose portion; the loop may be made previously, when it is possible to make it glide on the head. After drawing the portion with the check-knot on it sufficiently tight to place the head-piece in its proper situation, the same portion should be passed or hitched round the lower end of the head; the knots ought to lie between the branches of the lower jaw. If it is desired to have only one traction cord, the running-knot

or loop should be made at one end, and the check-knot a calculated distance from it (Fig. 116).

This forms a very simple and solid apparatus for exercising any amount of traction on the head, without much risk of danger to the fœtus.

A still simpler method consists in passing the middle of a ten or twelve foot cord behind the ears of the fœtus, carrying the sides down behind the lower jaw, and then twisting them outside the vulva until the two ends form one portion between the branches of the jaw. This, however, has rather a tendency in some cases to tilt the nose too much upwards.

Fig. 125.—Defays' Wire Extractor with the Torsion Rods.

With the smaller animals, cords cannot be passed around the head of the fœtus in the same manner as in the mare or cow, because of the want of space; and on the same grounds forceps are objectionable. For anatomical reasons, it is essential that the traction force should be applied behind the head, as if the sum of the expulsive efforts were directed there. With this object, Defays devised an apparatus which fulfils this indication, and is very simple and easily applied. It consists merely of two very pliable copper or brass wires—twisted picture-frame wire will answer admirably—about 16 inches in length, and looped in the middle, so as to be applied to the fœtus in the following manner: The first finger of the left hand, being passed into the vagina, serves to guide one of the loops towards the summit of and behind the fœtal head; and it then conducts the loop of the other wire beneath the head behind the jaw. This done, the two wires on each side are twisted by a little machine (Fig. 125) composed

of a thin iron rod in a handle, the other end of which is thickened and pierced by holes running nearly parallel to the stalk. Into these holes the two wires of one side are passed; the machine on each side is pulled up as close as possible to the head of the fœtus, and then, each being turned round three or four times, the neck is enclosed in a kind of noose or collar formed by the two wires (Fig. 126).

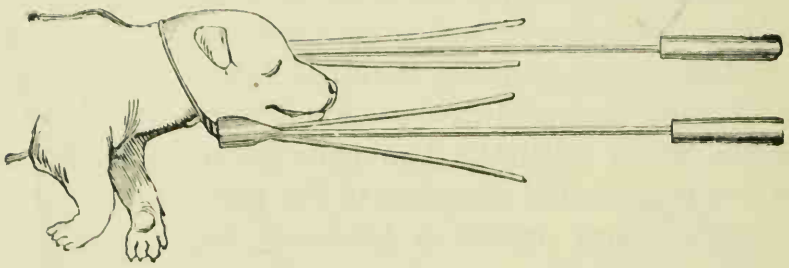

FIG. 126.—DEFAYS' WIRE EXTRACTOR APPLIED.

The rods are now withdrawn from the latter, and the fœtus can be extracted by exercising traction on the ends of the four wires outside the vulva. By this contrivance, delivery is effected without injury to the bitch, and, unless it is much decomposed, without separating the head of the fœtus.

A much simpler, readier, and perhaps more successful apparatus is that devised by Breulet, of Marche, Belgium,

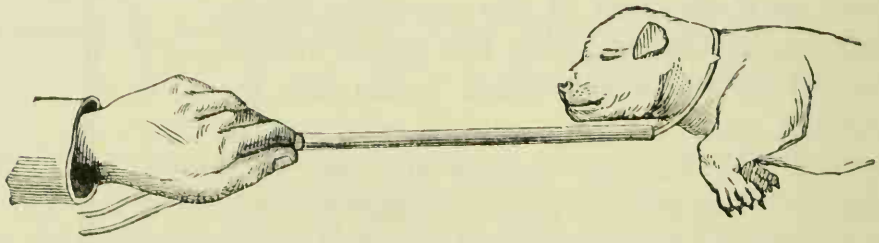

FIG. 127.—BREULET'S NOOSE FIXED ON THE FŒTUS.

which is very useful in the accouchement of small bitches, and might be successfully employed with sows, ewes, and goats. This apparatus is the same in principle as Defays' wire extractor, but there is only one wire. The principal part of the invention is a noose-tube, consisting of a tubular piece of round wood, from 4 to 6 inches long and $\frac{1}{2}$ inch thick. The wire may either be of copper, brass, or iron (catgut may be used for the same purpose), about 16 inches long; this is

doubled, passed through the tube to a certain extent, so as to form a loop or noose at the end. When it is to be used, the first finger of the left hand carries the loop into the vagina of the bitch, and slips it behind the occiput of the puppy; then the two ends of the wire are passed through the tube, and this is pushed into the vagina under the chin of the fœtus; the operator now tightens and secures the wire by giving it a turn round the first finger of his right hand, placing his thumb at the end of the tube (Fig. 127). A little traction then extracts the fœtus, and without doing it or the bitch the least damage. This instrument is exceedingly useful in canine obstetricy, even with the tiniest toy terriers, and may be employed to extract the puppies alive.

Pass- or Porte-Cords

When treating of certain presentations, it was remarked that, though the use of cords is urgently indicated in some cases, the arm is not sufficiently long to pass them to the region where they might be most effectively fixed; while the energetic uterine contractions paralyze the hand of the operator, and often prevent it manipulating accessible parts which it is desirable to secure by these means. In such circumstances the *porte-cord* or *pass-cord*, which has been sometimes referred to, is of great service. The instrument is of two shapes—*straight* and *curved*.

The *straight porte-cord* is usually a rod of three-eighths of an inch iron, furnished with a wooden handle at one end, and an eyelet or double opening at the other to receive the cord.

The *curved porte-cord* has the end through which the cord passes more or less bent, and in certain cases it is more useful than the straight one, from which it only differs in having this curvature.

Different forms of these instruments have been described, but in principle they are all really the same.

The straight one can be used to pass the traction cord around the limbs, or the neck of the lower jaw, and may act with the cord in pulling these towards the vulva; or, if properly constructed, it may also be most serviceable as a repeller in pushing them forward into the uterus. A very

good and simple pass-cord of this kind is that introduced by Darreau (Fig. 128 A, B), which can be employed as a retractor and repeller. Two of these may be used at the same time on two limbs. For instance, in the sterno-abdominal presentation,

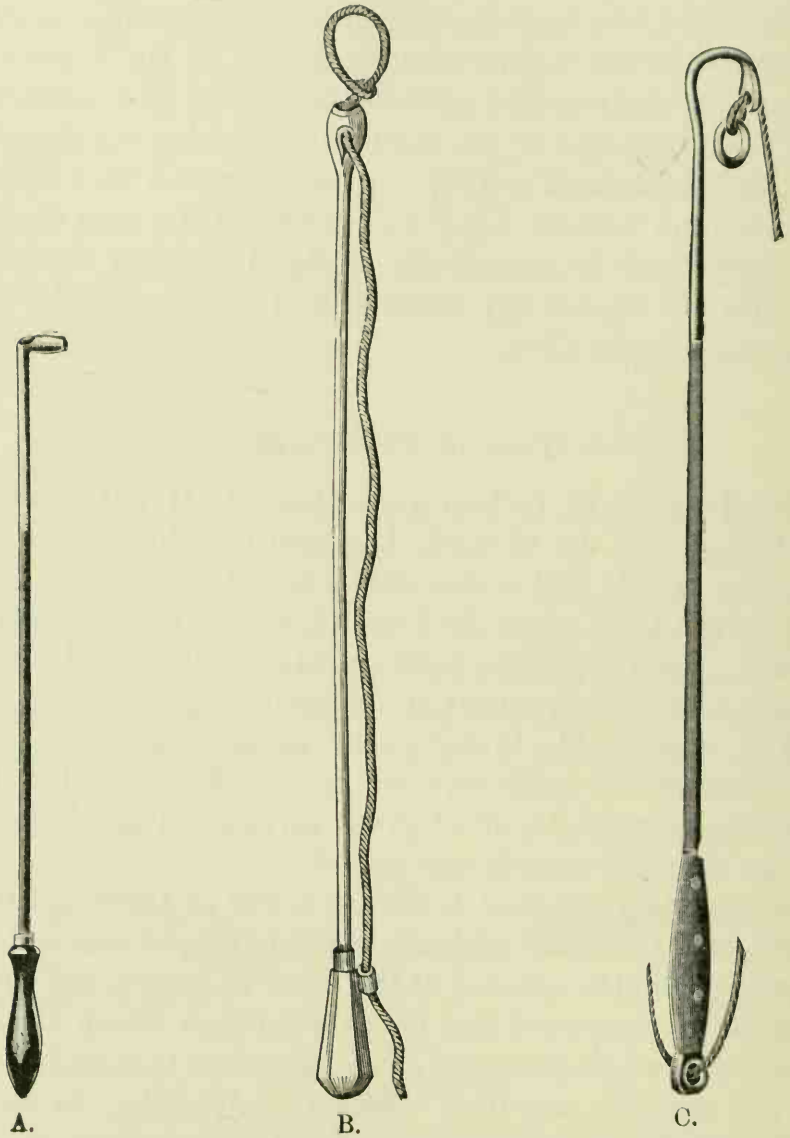

FIG. 128.—PORTE-CORDS, DARREAU'S PATTERNS.

when posterior version is decided on, the hind-limbs are corded in the usual way; then this repeller, armed with a noosed cord of sufficient length, is introduced, the noose passed on to the pastern or knee of one fore-limb, and the cord drawn tight and fastened around the handle. Another

pass-cord is attached in the same manner to the other fore-limb, so that each instrument becomes a solid fixture to the leg, and is confided to an assistant. The operator then pushes back the fore-limbs as far as possible by hand, while each assistant seconds his efforts with the repellers. When all has been conveniently adjusted, traction is made on the hind-limbs, the repellers being still employed to overcome the resistance of the fœtus and follow its movements.

The curved pass-cord has its uses in certain cases when the straight one cannot be serviceable—as in passing a cord round the head or bent neck, thigh, or loins; there are also several patterns of this instrument, but if the straight one is made of iron, it may be bent sufficiently to answer the purpose in the case of flexed limbs or bent neck. An ordinary walking-stick with a crook handle may, on an emergency, be made to serve this purpose by making one or two holes in the handle for the reception of the cord. Or when this cannot be procured, an excellent substitute will be found in a piece of iron or lead attached to the end of the traction cord, the weight of which greatly facilitates the passage of the cord around the straight or bent neck, hocks, or knees.

Tyvaert has for a long time made profitable use of a simple porte-cord. This is composed of a somewhat short piece of iron wire, about the thickness of a goose-quill, and bent a little round, the length and curve varying with the part to be secured. One end is turned to form a small ring, while the other is bent to make a hook a little longer than wide. A cord being attached to the ring end, the wire is passed round the part it is sought to seize; the hook end remains free, and afterwards receives the traction cord, serving to form a running noose on the part. This porte-cord is very simple, and may be made on the spot when required; it has proved most useful for securing the neck or hocks.

Binz's pass-cord (Fig. 129) is much used in Germany. It is sufficiently large to pass round the doubled neck of the fœtus, while its shortness allows it to be easily manipulated in the uterus. It is from 12 to 16 inches long, and made of wood or iron; at the bent end is an opening through which the cord passes. The instrument (named a *Geburtssonde* by

the Germans) is passed to the middle of the cord, and may then be introduced into the uterus, where, from its curvature and its shortness, it can be pushed behind or between the limbs, in the double of a bent neck, etc. The hand seeks the half of the cord on the opposite side of the part, and pulls it into the vagina; the instrument is then withdrawn, and the part is ready to be pulled at by the cord left encircling it.

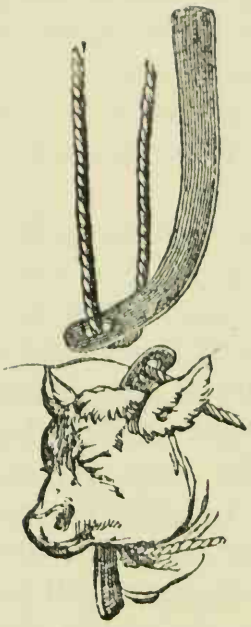

FIG. 129.—BINZ'S PORTE-CORD.

The ordinary curved pass-cord is introduced into the genital canal in the same manner as the other form, but with only a loop or ring (no noose) at the end of the cord; the curved portion is pushed around the part to be secured, and the hand, leaving it, is passed to the opposite side of the part, where it searches for the loop or ring, which, when found, is drawn into the genital canal. The instrument is then withdrawn, the cord remaining around the part; the free end of the cord is passed through the loop or ring, and being pulled at, the limb, neck, body, or whatever it may be, is secured in the noose so formed, and traction can in this way be directly exerted upon it.

Crotchets or Hooks.

Obstetrical *crotchets* or *hooks* are iron or steel instruments of variable dimensions, more or less curved at one end, which is blunt, sharp, or pointed, the other end having a ring or eyelet if short, a handle if long. The latter is from 30 to 36 inches in length (including the handle), and acts directly on the fœtus without any other appliance intervening; while the short hooks have cords attached to them, or they may fit on the finger of the operator by means of a ring. Some sharp crotchets are jointed at the end curve, so as to permit them to be more readily and safely introduced into the genital passage by bringing the sharp point near the stalk, the curve being restored by a spring when the fœtus is

reached. But the advantages of the jointed hooks are very few, while their strength is impaired and their expense increased. In using the long or short pointed crotchets, risk of injury to the maternal organs may be obviated, if the hand is not found sufficient to guard the instrument during its introduction, by fixing the point in a piece of cork or soft wood, to which a long piece of twine is attached; when the crotchet is required to be implanted in the fœtus, this shield may be removed from the point, and withdrawn from the genital organs by pulling at the end of the twine outside the vulva.

Blunt and sharp crotchets are much employed in veterinary obstetrics, and are very valuable. The blunt crotchets are more particularly resorted to when the fœtus is alive, and it

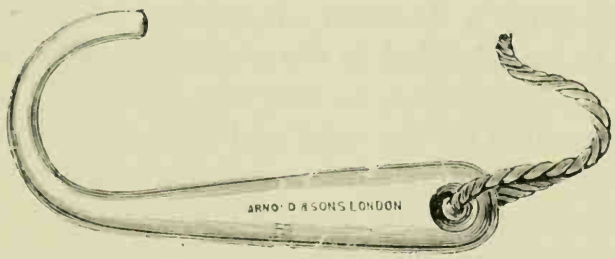

FIG. 130.—SHORT BLUNT CROTCHET.

is hoped to extract it before it is dead; they are most serviceable in correcting deviations of the head or limbs, and the long crotchet is especially useful in finding and straightening the latter. The curve should be about 4 inches wide. The finger crotchet may be usefully employed when the hand is fatigued or paralyzed by the uterine contractions. Blunt crotchets of a much smaller size than those required for the larger animals can be most successfully employed in delivering the sow, sheep, goat, bitch, or cat. In the bitch a small hook, shaped like a buttonhook, is often of exceedingly great service in removing a puppy in dystokia. Frequently the operator can use it successfully in the smaller dogs, in which forceps cannot be applied.

With the sharp crotchet, the curve should certainly not be very wide; the smaller it is, the more readily it can be passed into the genital passage, and the less chance of injury is there to the mother or operator; it should not be greater than

the hand can cover. At the same time, if the curve is too small, the crotchet does not obtain sufficient hold of the fœtus, is readily torn out, and for this reason may be most dangerous. The point should be so bent as to readily penetrate the part in which it is determined to fix it, and the

FIG. 131.—SHORT BLUNT CROTCHET, HINGED.

angle of the curvature should be such that the more the crotchet is pulled at, the deeper and more firmly the point will enter.

There is rather a diversity of opinion with regard to the preference to be accorded to the crotchets, some practitioners preferring the short ones, as they can be readily carried into the uterus guarded by the hand and moved about there, so as to be implanted in the most convenient part of the fœtus, while the cords attached to them allow traction to be made in the most favourable direction. Other obstetrists prefer the

FIG. 132.—SHORT SHARP CROTCHET, WITH ROUND POINT.

long rigid crotchet, which they affirm is more easily placed, one hand guiding the point through the passage, the other hand acting on the handle.

These preferences depend very much upon whether the operator is more practised in the use of one or other of the crotchets, and also, doubtless, upon circumstances peculiar to each case requiring the employment of such instruments. Both long and short crotchets are most useful, and the obstetrist should have several of each, of various forms and dimensions, so as to be able to select that which is best adapted to meet the requirements of particular cases.

These instruments afford a simple and ready means of

getting hold of the fœtus in regions of its body which the hand cannot possibly reach, or, if it did, where it could do very little service either from the shape of the part, its

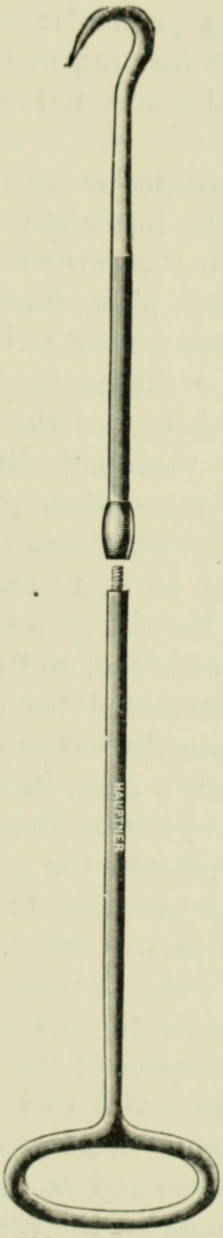

FIG. 133.—LONG POINTED CROTCHET FOR LARGE ANIMALS.

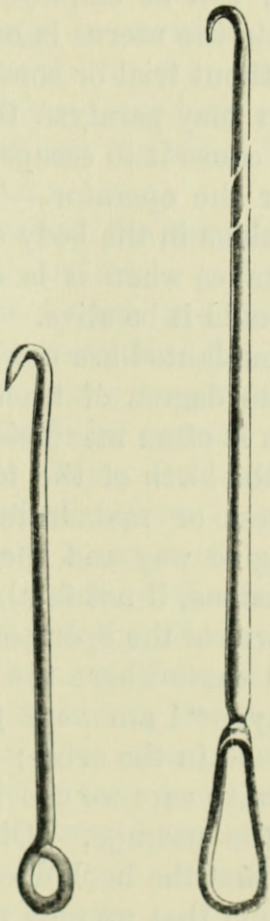

FIG. 134.—LONG POINTED CROTCHETS FOR SMALL ANIMALS.

slipperiness, or the paralyzing effect of the uterine contractions on the hand and arm of the operator. They can also be profitably employed in cases in which cords and

halters are useless; for not only will they serve in allowing traction to be made on parts which actually present at the inlet, but they can also be utilized in effecting those mutations which are necessary in order to bring particular parts of the young creature in front of the pelvic opening or through the genital canal, and which the hand could not seize or move.

It is no doubt true that the sharp or pointed crotchets have certain disadvantages which must not be lost sight of, and which lead to preference being given to the cords or halter when they can be employed. In the first place, their introduction into the uterus is not such an easy matter as it might appear without trial or consideration; for the contractions of this organ may paralyze the hand which carries the instrument and cause it to escape, or its point to wound either the mother or the operator. Their employment often produces serious lesions in the body of the fœtus, which are certainly of no importance when it is dead, but may be of much consequence should it be alive. Then, again, the tissues into which they are implanted are not very firm or resisting, so that only a moderate degree of traction can be expected from them, and which is often insufficient to overcome the resistance that prevents the birth of the fœtus. In such a case, if, through forgetfulness or maladroitness of the operator, the tissues suddenly give way and the crotchet slips into the maternal organs, serious, if not fatal, injuries may be inflicted; or the hand or arm of the operator may be the part to suffer.

"In all cases where the head of the fœtus is back," Cartwright says, "I am very partial to using the long sharp-pointed hook in the orbit; even if the head is at the *extreme* distance, with care we can insert it in the orbit and get the head in the passage. Of course, it requires great care in watching that the hook does not break loose and do mischief. I have found that we may pull by the hook in the orbit with great force, without tearing the skin of the calf, provided the latter is not in a decomposed state. From my experience, I can speak highly of the hooks; indeed, you cannot get the head up without them sometimes." And in embryotomy they may be most usefully resorted to for many purposes.

Reference will now be briefly made to the parts of the

fœtus upon which the crotchets can be most effectively employed, and the manner of employing them.

Parts into which the Crotchets may be implanted.—The parts into which the crotchets may be implanted are numerous; but those which are selected by the obstetrist will not only depend upon the nature of the malpresentation or malposition, but also upon the simplest indications for the adjustment of these. When the desirable part has been reached, the point of the crotchet is inserted in such a way that the instrument is directed towards the source of traction—the assistant. When blunt crotchets are employed, except in cavities, it will be necessary to make an incision through the skin before they can be inserted. Sometimes the sharp crotchets cannot be used without making these preliminary incisions, but then the instruments must be rather blunt.

The best parts for implantation are—(1) the *muscular tissues*, (2) the *head*, (3) the *spine*, and (4) the *pelvis*.

1. *The Muscular Tissues.*—These tissues are not advantageous for the employment of the crotchets; for although they are easily inserted, they are as easily torn out. Nevertheless these instruments, when fixed in certain muscular regions, such as the croup, thighs, loins, and neck—more especially the latter—may render useful service in rectifying deviations, as the skin offers a good amount of resistance. But, from the fragile and yielding nature of the textures, it must be borne in mind that the hand of the obstetrist should never leave the crotchet while traction is made on it, and that its position in them must be most attentively noted, in order to guard against accidents arising from its tearing away.

2. *The Head.*—The head offers many good points for implanting the crotchets—such as the symphysis of the lower jaw, the palate, and the orbit, as well as the ear and angle of the inferior maxilla on particular occasions.

It must be observed, however, that all these points are not of equal value. The *maxillary symphysis* is convenient, but not very firm; moderately strong traction will rupture it, and damage may then occur. Still, there are times and occasions when this part may be advantageously seized by the crotchet, which may be inserted in two ways: the point

of the instrument may be passed from below the chin into the mouth, or from the cavity of the latter, through the mucous membrane beneath the tongue, to below the chin. The first is generally preferable. When traction begins, the operator must be on the lookout for tearing away of the two branches of the jaw.

The orbital cavity is the best part of the head for a solid hold. Some authorities have expressed doubts as to the propriety of fixing a crotchet in the ocular cavity of a living fœtus, from a belief that the eyeball must be damaged, and Rainard goes so far as to advise that it should only be done when the creature is dead; though he adds that, if there is no other means of remedying a deviation of the head in the living calf, it is well to attempt it, "as it is better to have a living, if blind, calf, than a dead one with both its eyes intact.

But it is rare indeed that the eyes are seriously damaged by fixing the crotchet in their socket; and innumerable

Fig. 135.—Schaack's Crotchet.

instances testify that, if the fœtus is alive, the ocular globe is retracted to the bottom of the cavity when the instrument begins to be inserted, and so escapes injury. Schaack, who has freely resorted to this mode of adjusting the head or neck—in the sheep and goat more particularly (the smallness of the pelvis not allowing any other means to be employed)—describes his manner of operating as follows: "The crotchet I use," says he, "is a solid (or long) one; the point is blunt and slightly flattened (Fig. 135). When it is desired to pull at the head of the fœtal goat or lamb, the left hand at first seizes the nose, and the crotchet is fixed in the right orbit; with the right hand the other instrument is passed into the left orbit, the thumb of the left hand keeping the hook in the other orbit by pressing the stalk against the cheek. In this way I can pull with the two hands on both orbits, so as to keep the nose in a good direction." He has never seen the point of the crotchet cause the slightest injury to the globe of the

eye, although he has had, in the majority of cases, to pull very hard. The means has answered very well. And Cartwright states that "it is astonishing how wounds heal up in the cheek where hooks have been in the orbit. I have had two or three men pulling at the rod (of the crotchet), and the hook did not break out."

This immunity from injury in the case of the living fœtus does not, however, absolve the operator from exercising all due care in fixing and pulling at the crotchet. The inner aspect of the orbital cavity is the most favourable, and if the fœtus is alive, the blunt instrument must be first tried, the sharp-pointed one being kept in reserve until this has failed; or it may be used at first when the young creature is dead.

The *palatine arch* affords a very solid and useful hold for the crotchet, and many obstetrists have successfully utilized it in extracting the fœtus, some authorities—among them is Schaack—asserting that hooking this part is easier, and the results more certain and direct, than fixing the instrument in the orbit. The stalk of the crotchet is somewhat long; the hook end is passed sideways into the mouth of the fœtus, and over the tongue until it gets beyond the palate, when it is turned point upwards and seizes the base of the vomer. A very strong degree of traction can be made on this part without inconvenience to the young creature. It appears to be an excellent situation to plant the crotchet in the calf, particularly if it be dead, and it is desired to effect extraction as quickly as possible. It may be also employed in the foal, the only risk being more or less disunion of the palate, which may render sucking difficult or imperfect for a short time after birth.

Of course, the head must be in a good position either in the inlet or in the genital canal before the crotchet can be placed behind the palate. Traction must also be moderate and steady, and the usual precautions observed.

3. *The Spine.*—When embryotomy is practised or the fœtus is dead, the bodies of the vertebræ or their transverse processes, or the ribs, afford excellent hold for hooks, though care must be observed in placing them securely, and guarding them when they are being pulled at.

4. *The Pelvis.*—In posterior presentations, when cords cannot

be employed to the hind-limbs, the loins, or the croup, or when they have not sufficient power, then crotchets must be resorted to ; and with this view the fœtal pelvis offers several very advantageous points. After removal of one or both hind-limbs, the *cotyloid cavities*, by their depth and the hardness of their walls, are admirably adapted for receiving the hooks and withstanding energetic pulling. If both limbs are amputated from the hip-joints, then a hook may be placed in each cavity ; if ablation of only one limb has been effected, then one hook will be most useful.

The *pubic arch* and the *obturator foramina* of the pelvis are likewise well suited for crotchet traction in the posterior presentation when the fœtus is dead. In some cases the sharp-pointed crotchet may be passed directly through the rectum, and pushed forward so as to seize the border of the pubis, the margin of one of the oval foramina, the base of the sacrum, or the shaft of the ilium, care being taken that the point does not pass through the skin. Or the crotchet may be passed from without inwards—the safest method—after the pelvic bones have been denuded as much as possible of their soft tissues. This is, perhaps, the most practicable method if the hind-limbs have been already removed. But if they have not, then all the soft tissues of the fœtus—from the root of the tail to the ischial arch—should be largely incised, and the hand passed through the incision into the pelvis, to remove the viscera. The crotchet is then pushed into it, and planted either on the brim of the pubis or in the obturator foramen.

Crotchet-Forceps and Forceps

The introduction of forceps into human obstetricy marked a new era in the accoucheur's art, and has been productive of the greatest benefit in difficult cases of parturition in women. But they have not yielded much service to the veterinary obstetrist, except with the smaller animals ; notwithstanding that Hurtrel d'Arboval, at the commencement of this century, asserted of the forceps that there are circumstances in which great advantages might be derived from them, and that their use is perhaps the best means of completing parturition when it cannot be terminated naturally. Attempts have been

made at various times to introduce them into general use for the larger domesticated animals, and various models—more or less modifications of the human patterns—have been proposed, but with very little, if any, success.

The forceps used by the accoucheur of woman are, as is well known, composed of two branches or blades, which are nearly or quite alike, and form levers of the first order; they are united at the middle by a fixed or sliding joint, and one end—the "bow," or widest part—which is intended to grasp the fœtus, is *fenestrated*, or perforated by a wide opening; at the other end is the handle.

The reason why forceps have never come into general use in veterinary obstetrical operations—except with the smaller animals—is not so much from a prejudice against novelties

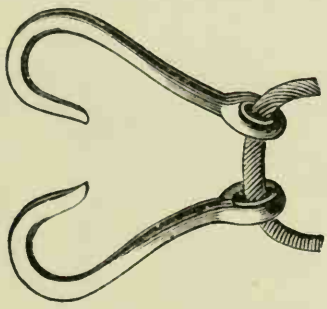

FIG. 136.—SIMPLE SHORT CROTCHET-FORCEPS. (SMALL HARMS.)

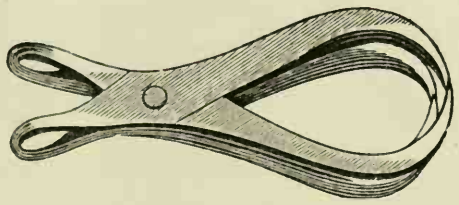

FIG. 137.—PARTURITION HOOK. (VOGEL'S.)

and innovations, as because they are really not adapted for this kind of practice, unless in a very modified form, to be presently noticed. Rainard remarks: "Medical men will be astonished that I have not mentioned the *forceps*, from which they derive such great advantages. This instrument, which can seize a round head, like that of a child, when each blade fits exactly throughout its whole length, will have much less hold on that of animals, which is elongated, flattened at the sides, and otherwise but little yielding. When the forceps is applied to the foal or calf, it slips and is useless. Otherwise, the readiness with which cords can be attached to the head and limbs renders these in every way preferable to this instrument. What the forceps cannot do, the cords can; and they have the additional advantage that they scarcely occupy

any space in the pelvic canal. The pelvis of our animals is nearly rectilinear; with the cords we pull in a straight line; what more could the forceps do? The entire hand can be introduced freely into the pelvis, and moved about easily. This cannot be done in human accouchements." There is no known forceps capable of affording such a solid purchase, and at the same time one so harmless, as good cords fixed on the pasterns, or a halter properly placed on the head.

Though an instrument resembling the human forceps is not at all adapted for extracting the fœtus in such animals as the mare or cow, and though in the cords and halter an excellent substitute is found, yet modified forceps, which might be designated—if not from their shape, at least from their action—*crotchet-forceps*, have been long employed by veterinary obstetrists, and with much advantage in certain cases. The

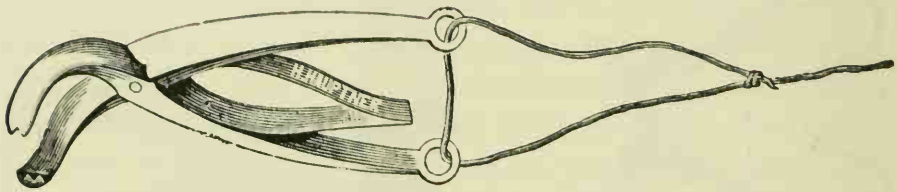

FIG. 138.—CROTCHET-FORCEPS. (TALLICH'S.)

simplest of these consists merely of two short crotchets, the points opposite each other, and a cord passing through both eyelets (Fig. 136). The hooks can be inserted near, but opposite to, each other, on each side of the spine, pelvis, head, flanks, etc., the cord, when tightened, bringing them closer together, and so concentrating the traction. A longer crotchet-forceps, with a wider curve at the points, is not infrequently used with success in breech presentations with the hind-limbs retained; the points are inserted towards each flank, penetrating as far as the shaft of the ilium.

To render their hold more secure, these crotchet-forceps are sometimes jointed; the points are sharp, and one point lies in a slight notch on the opposite one, to render their introduction into the uterus more safe, and also to prevent accidents, should the tissues in which the points are implanted give way. A cord passes through eyelets at the extremities of the blades, as in the other models; but some-

times the eyelets are in opposite directions, and the ends of the branches in which they are pierced are bent towards each other.

Some of the models of crotchet-forceps have a spring introduced between the branches, and behind the joint, as in Tallich's short instrument (Fig. 138), the jaws of which are bent to one side, and toothed; it is intended to secure a hold of the fœtus, and make traction on parts to which neither cords nor crotchet can be applied—as the skin of the cheek, or the nose or ear, when the head is thrown back towards the flank in the anterior presentation.

Another instrument of this description has been devised by a Belgian veterinary surgeon, André, which he designates a *pince-forceps* or *accroche-fœtus*. This is not unlike the instrument fixed in the nose of a bull in order to lead the animal.

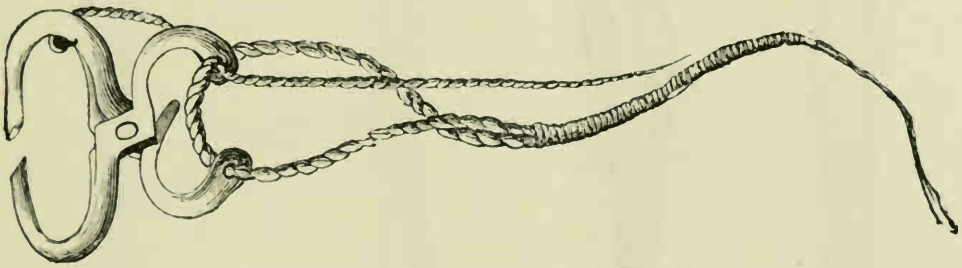

FIG. 139.—ANDRÉ'S CROTCHET-FORCEPS.

The points of the jaws are bevelled to fit into each other, the bevel being grooved. In one of the jaws is a small hole, into which is fixed a string that passes through the eyelet at the end of the opposite branch, and which is pulled at when it is desired to open the forceps. The two branches behind the joint are very short, and through the eyelet of each passes a strong cord, the two ends of which soon unite into a single piece (Fig. 139). When this is pulled at the jaws close, as in the other jointed examples, and they remain all the more firmly closed as the traction is great. In order to use the instrument, it is passed by the hand into the uterus; the jaws are fixed on the part to be drawn at, by first pulling, outside the vulva, at the string which opens them, pushing the points against or over the part; then, when this is between the points, drawing at the single cord which closes them. This is acknowledged to be rather an instrument for

holding or fixing a certain region, and not for exercising tractile force upon. André has often applied it successfully to the lower and upper jaw, or to the ear, to bring the head into a good position; to the *tendo Achillis*, in order to raise a hind-limb, which the hand alone could not do; to the fore-limbs, etc.

With regard to the smaller animals, such as the bitch, sow, sheep, or goat, in them we may often use the crotchet, small

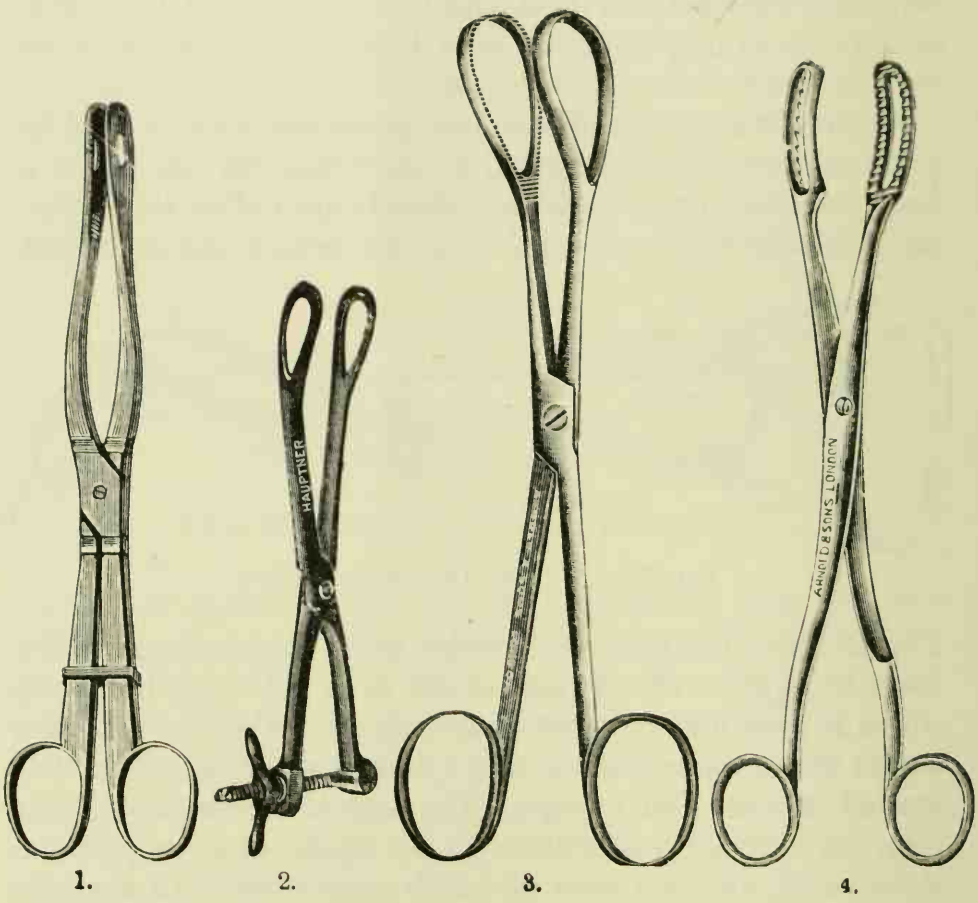

FIG. 140.—PARTURITION FORCEPS FOR THE SMALLER ANIMALS.

1, Möller's; 2, De Bruin's; 3, Hobday's; 4, Sewell's.

ordinary forceps, or a small-sized model of the human forceps, with advantage. Various patterns are in use, some of them fenestrated, others not; some resemble polypus-forceps, while others, again, are grooved, serrated, or toothed, at the ends of the blades. An essential which should not be lost sight of in the forceps for such small animals as the

bitch or cat is that the blades should be sufficiently long to seize not only the head, but much, if not all, of the body of the fœtus. If they are short in the blades, they cannot be made to grasp sufficient of the fœtus to remove it; while the joint being close to the vulva, or even within the vagina, is likely to pinch the mucous membrane, and cause the mother considerable pain.

Another point of importance in selection is that the handles should not overlap. In applying these instruments, great care must be taken not to pinch or grasp the mucous membrane of the uterus or vagina instead of the fœtus. This will especially occur if the handles overlap.

When the bitch is large or of moderate size, forceps may be employed with advantage, though they must be of various

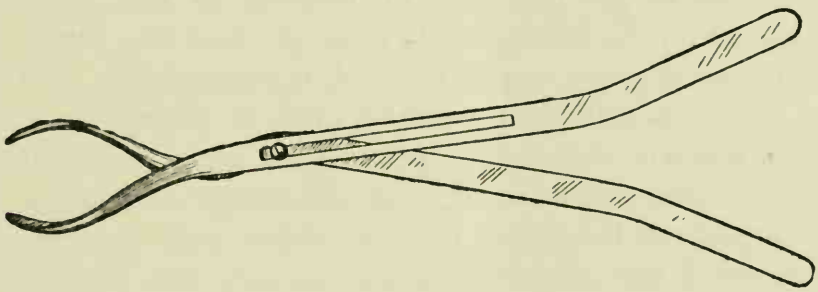

FIG. 141.—MCKENNY'S BITCH FORCEPS.

dimensions. But when the animal is very small, as is usually the case in difficult parturition in this species, the space occupied by the bows of the forceps—if they are ever so thin—so increases the volume of the mass which has to pass through the pelvic canal that this instrument cannot be used.

A very useful instrument which does much to overcome this defect has been invented by J. McKenny, Esq., M.R.C.V.S., Dublin. Each blade of the forceps ends in a flattened curved portion. A small screw about the middle of one blade slides in a slot in the other, thus presenting a freely movable gliding joint. One blade with the slot in it may first be put in apposition in the uterus, then the other in the closed position of the forceps is passed into the vagina, and the forceps is opened so that the second blade may reach the opposite side of the fœtus, or portion of the fœtus.

A good plan to adopt in order to facilitate the application

of the forceps is to have the fœtus fixed at the entrance to the pelvis by abdominal manipulation of an assistant. Before applying traction, it is always necessary to examine with the finger to make certain that the fœtus only is included in the blades of the forceps.

THE EMPLOYMENT OF FORCE IN DYSTOKIA.

In connection with obstetrical operations, a rather important question to be considered is the employment of *force* in the artificial extraction of the fœtus. For, as has been shown, more or less energetic traction is very frequently needed to remove it from its parent; and those who do not understand, or are inexperienced in animal obstetrics, are sometimes astonished, if not horrified, at hearing of the amount of pulling which the fœtus has to undergo, and the parent sustain, before delivery can be effected in some cases. Yet force is as a rule absolutely necessary, even in embryotomy; and though some of the various points with regard to it are not yet sufficiently ascertained, and differences of opinion exist with regard to them, yet it is a subject well deserving the attention of the obstetrist, and especially the junior practitioner.

The indications for forced extraction have been given in preceding chapters; they are chiefly to be found in the smallness or deformity of the maternal genital canal; excessive development of the fœtus—wholly or partially, or distortion; malposition of parts which cannot be remedied; or morbid conditions that hinder birth. Forced extraction is usually preferable to embryotomy and Cæsarian section in those cases in which the passage of the fœtus—whether alive or dead—appears to be possible without serious injury to the mother; and because of the greater width of the pelvis of the mare, it is more likely to be successful in that animal than in the cow.

Direction of Traction.

With animals, the pelvis is somewhat cylindrical; and its axis—almost rectilinear—can readily be determined by a line passing from the centre of the anterior circumference to the

centre of the vulva, or somewhat towards the middle of the line uniting the two superior ischiatic tuberosities. Traction should therefore be made in the direction of this axis (Fig. 142, AB); and this line of traction, happily for the veterinary obstetrist, and thanks also to the flexibility of the

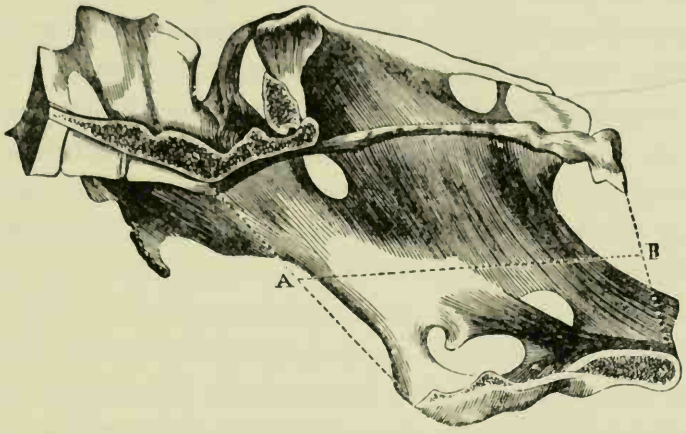

FIG. 142.—DIAGRAM OF THE PELVIC AXIS. (SAINT-CYR.)

cords which, in his practice, take the place of the forceps, offers no serious difficulty. At p. 194 it was shown that this direction can vary, and may be modified according to the presentation—and more particularly the position—of the fœtus, and also according to the period of labour.

Degree of Traction.

When passing through the pelvic cavity, the fœtus undergoes a certain amount of compression, proportionate to the uterine contractions or the external traction which determines its progression outwards; at the same time, this compression produces a kind of reaction in the body of the fœtus, and gives rise to an eccentric pressure against the walls of the passage, related to that which itself experiences. The question is therefore limited to the amount of force necessary to overcome the resistance that prevents the onward progress of the fœtus, without injuring either the latter or the parent. In veterinary obstetrics we have no fixed data to rely upon; but the experiments of Joulin, Delore, and Poullet, alluded to by Saint-Cyr, may afford some idea of the resistance offered

by the pelvic girdle to the eccentric pressure. These authorities found that if a rounded body—a ball, for instance, to represent the head of a fœtus—is attempted to be pulled through the pelvis of a woman, it requires a force represented by 375 to 441, and even as much as 635 pounds (estimated by the dynamometer), to produce such serious lesions as fracture in the bones or disunion of the symphyses. But it must not be concluded, from this result, that such powerful traction can be practised with impunity in woman. In the first place, the child could not be extracted alive, for its existence appears to be compromised if the degree of traction by the forceps exceeds from 132 to 154 pounds; and in order that the pelvis of woman could resist such pressure, certain conditions are required which we never meet with in ordinary practice; for instance, the pressure should be equally applied to every part of the bony girdle in contact with the head of the fœtus. But this does not take place with the ordinary forceps, which, even in the hands of the most expert accoucheur, not only acts as a traction agent, but at a given moment is unfortunately transformed into a lever of the first or second kind, whose power is incalculable, and which, resting on two opposite points of the pelvic circumference, may burst it, without the dynamometer showing anything more than a relatively feeble degree of traction.

Otherwise, it is not only the bones which have to be considered, but also the soft parts, which, pressed between the fœtal head and the hard pelvic circumference, may be bruised, crushed, or lacerated, to a variable degree, if the compression exceeds a certain limit. This pressure, however, is always considerable; for, according to Chassagny, when a tractile force of 50 kilogrammes is exercised on the head of a fœtus seized by the ordinary forceps, we may calculate that each square centimetre of surface of the pelvic walls sustains a pressure of 1,800 grammes, even in the most favourable conditions, though it may be as much as 6 kilogrammes or more, according to circumstances.

From some measurements made by Saint-Cyr, the pelvis of the mare and cow, which is nearly cylindrical, may be reckoned at 1,600 square centimetres (248 inches) of internal surface; and it is on this expanse that is distributed, in a

nearly uniform manner, the eccentric pressure which the chest of the fœtus transmits to the walls of the genital canal, to which it is very closely applied during its passage outwards. If, then, it be admitted that the total of this eccentric pressure amounts to about one-half the tractile force expended on the fœtus, it will be easy to find, by a simple calculation, the pressure on each square inch. Supposing the traction to be equal to 1,540 pounds—the estimated strength of seven or eight men pulling with all their force at the cords—the pressure on each square inch would be about $7\frac{3}{4}$ ounces, or one-half that exerted on the same extent of surface with a tractile force of 132 pounds in woman!

Saint-Cyr does not pretend that these calculations give a rigorously exact measure of what really takes place during parturition; but he believes they may assist, up to a certain point, in explaining certain facts in comparative obstetrics which otherwise would remain obscure—how, for instance, natural birth, which is always so painful in woman, is comparatively painless in the larger animals; and why traction, the very idea of which alarms the accoucheur of woman, is in the majority of instances so well sustained by the veterinary surgeon's patients.

It must be confessed, however, that we have as yet no certain data by which we can estimate the exact amount of force necessary, or which may be employed without danger; and on this point the opinions of the best authorities are widely divergent. Some declare for moderate traction—two, three, or four men at the most, pulling simultaneously at the cords with all their force, are, in their opinion, quite sufficient in all cases if well managed; and they assert that it is rash and dangerous to employ more. Others do not hesitate to have recourse to more energetic traction, and are not afraid of employing the combined strength of six, eight, or ten strong men, being convinced that the parent suffers more from protracted labour than from powerful traction—and not infrequently their success justifies their boldness.

Donnarieix admits that three assistants are usually sufficient with the cow—one at the head, another at the tail, and the third to aid the operator; while ten are needed for the mare—one at the head, another holding the rope which con-

fines the limbs of the animal and prevents its doing damage, a third to hold the tail, a fourth to assist the operator, and the other five or six to pull at the fœtus when necessary. Zundel, however, is of opinion that these numbers are somewhat exaggerated; very often not more than three assistants are required for the cow, and if more than six are needed for the mare it is better to have recourse to mechanical means, as too many assistants hamper the operator, and are often in each other's way, while their united strength cannot be usefully applied.

The assistants should be strong, and have had some experience in handling animals; some of them maintain the creature in a favourable position, while the others aid the attempts at extraction, under the orders of the operator. Precautions should be adopted to prevent accidents—especially to the assistants—from the struggles or defensive movements of the animal; and if the traction is severe, the latter should be supported against it by assistants pressing on the buttocks, by holding a rope or band against these—or even by placing the hindquarters against the half-door of the stable. The tractile efforts should be made simultaneously without jerking, in a continued and energetic manner, and always in the direction of the axis of the pelvis—in a straight line behind the animal. The direction of the traction may, however, be a little downward in the anterior presentation, lumbo-sacral position, until the withers have passed through the inlet, as by this means the top of the withers is depressed, and this part enters the pelvis before the sternum. The operator stands behind the mother, his hands on the sides of the vulva, which he depresses with the cubital border of one hand, while with the back of it he separates the lips, and prevents their being abraded by the cords. It is better to engage only one shoulder of the fœtus at a time, if possible; and when the sternum and one shoulder have been carried into the passage, then the other shoulder is brought forward by directing the assistants to pull a trifle towards the opposite side. By acting in this way with care, and by slow though continued efforts while the parent is straining, delivery will be effected, if this be possible by traction. The operator must not act hurriedly or brusquely, and his hand should carefully

attend the advance of the fœtus, facilitating its passage, and aiding the progress of the haunches by passing his open hand between them and the maternal pelvis.

In the posterior presentation, when at least one assistant must be told off to each cord, the traction should be moderate, or even gentle at first, until the operator's hand has adjusted the fœtus as much as possible. In addition, the latter, besides directing his assistants, must frequently himself guide the traction by the disengaged hand, and personally exert himself in the extraction of the young creature, separating the lips of the vulva, and pressing them towards the pelvis when they are pushed outwards by the advancing fœtus, lubricating the latter and the genital canal when necessary, etc.

With the smaller animals the operator himself applies the needed force, though an assistant is usually necessary to hold the creature. Generally, very little traction can be made, because of the danger of tearing the fœtus in pieces, and what is employed should be gentle and sustained; indeed, the fœtus should be held steady, traction only made during the expulsive efforts of the mother, and then lightly and steadily

Means for Developing the Necessary Force.

Hitherto the employment of human or manual force in the extraction of the fœtus has only been considered, and this, of course, is that which is generally resorted to at first. But it is not the only force that may be employed, and especially if it is desirable to exercise very powerful traction. It is true that empirics and amateurs have often adopted the barbarous expedient of attaching the cords fixed on the fœtus to a horse or ox, and by making the latter exert its strength, to tear the young creature through the maternal passage. Rainard mentions that, in the Camargue, those who have the charge of droves of mares, not having the services of a veterinary surgeon, yoke another mare to the cords they fasten on the fœtus, and deliver the parturient animal in this cruel fashion. Being destitute of anatomical knowledge, they act blindly; and, not understanding how to adjust a malposition, the foal is nearly always extracted dead, and only too frequently the mother perishes.

With the object of extracting the fœtus by force when manual traction is not sufficient, the *windlass, capstan, wheel, cart, and pulleys,* have frequently been used, and with great benefit. Many veterinarians consider the employment of machines as barbarous as ox or horse traction, but this opinion is scarcely just. They say such machines are blind instruments which cannot be directed at will, and they prefer increasing the number of men indefinitely rather than resort to them.

But many of the most intelligent and experienced veterinary obstetrists speak of the great utility of these machines; and it may be agreed that whenever the combined strength of six men is not sufficient to extract the fœtus from the larger animals, no one should hesitate to employ one of these articles.

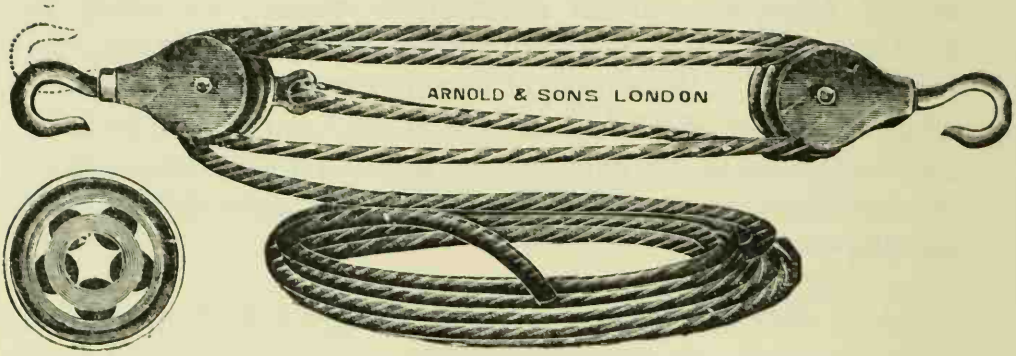

FIG. 143.—OBSTETRIC PULLEYS.

Not only can a greater tractile force be developed by them, but this force may be diminished or increased at will, and as gradually as circumstances may require. In this direction, though the windlass, capstan, or wheel, may be utilized, yet for convenience in application, portability, and steady graduated traction, nothing can approach the light obstetric pulley (Fig. 143).

When very powerful traction is required, whether manual or machine, there is the risk—particularly if the animal is standing—of dragging it backwards until it falls, or doing it some injury unless the precaution is adopted of fixing it in some way. It is obvious that there is great danger—indeed, cruelty—in attaching it merely by the head or neck, and allowing this to bear all the strain. It is necessary to render the creature immovable by passing cords, bands, or a sack.

behind the thighs and above the hocks, bringing the ends towards the animal's shoulders, and maintaining them there either by assistants or by attaching them to the manger or any other part sufficiently strong. A wooden bar placed behind the thighs and secured to the stall-posts is also serviceable; as is likewise an ordinary harness breeching, the front parts being secured to rings in the wall or manger. In some cases, vigorous assistants, by placing their back against the haunches of the animal, will offer sufficient resistance to its displacement. Many practitioners prefer throwing the animal down, if it is standing, in order to avoid the dangers of being dragged; Schaack even asserts that the body when lying on the ground increases the expulsive efforts, and keeps the fœtus in the plane of the pelvis. Donnarieix is not afraid of seeing the animal dragged a little, and recommends that the traction should not cease in consequence. Nevertheless, during decubitus the operator is more quickly fatigued, besides being restrained in his movements; the necessary manœuvres are more difficult to perform, and the weight of the fœtus is often an additional obstacle. And even when the creature is lying, if the traction is very strong, it is often necessary to prevent the body being drawn backwards.

All these inconveniences being recognized by Baron, in 1858 he introduced an obstretrical machine in the form of an apparatus for producing sustained traction (*appareil à traction soutenue*) in the extraction of the fœtus. This apparatus presses against the hind-quarters of the parturient animal, and owing to its construction it can not only develop a very energetic extractive force in the gentlest and most inoffensive way possible, but itself produces the counter-extension in an exactly proportionate degree.

The principal parts of the machine are—A kind of horse-collar (Fig. 144, A) with three stalks (B, C, D) intermediate between this collar and a broad, fixed, female screw (E), which receives a movable screw rod (H) that bears a revolving hook and chain (K) at one end; the other end of the chain has also a hook to which the cord or cords fixed on the fœtus are attached. The collar is made of several pieces of light wood superposed, and bound together by an iron band applied

to its posterior surface. This band is perforated by three screwed holes placed in a triangular position, and which receive the iron stalks. The anterior face of the collar is so fashioned as to fit closely on the hind parts of the animal, the space for the passage of the fœtus being about 20 inches in diameter. The intermediate stalks (B, C, D) serve to transmit to the collar the pressure exercised by the female screw; they are about 40 inches long, and each is composed of two pieces, one of these being hollow (4, 5, 6), the other solid (1, 2, 3): consequently one fits into the other, and the end opposite the

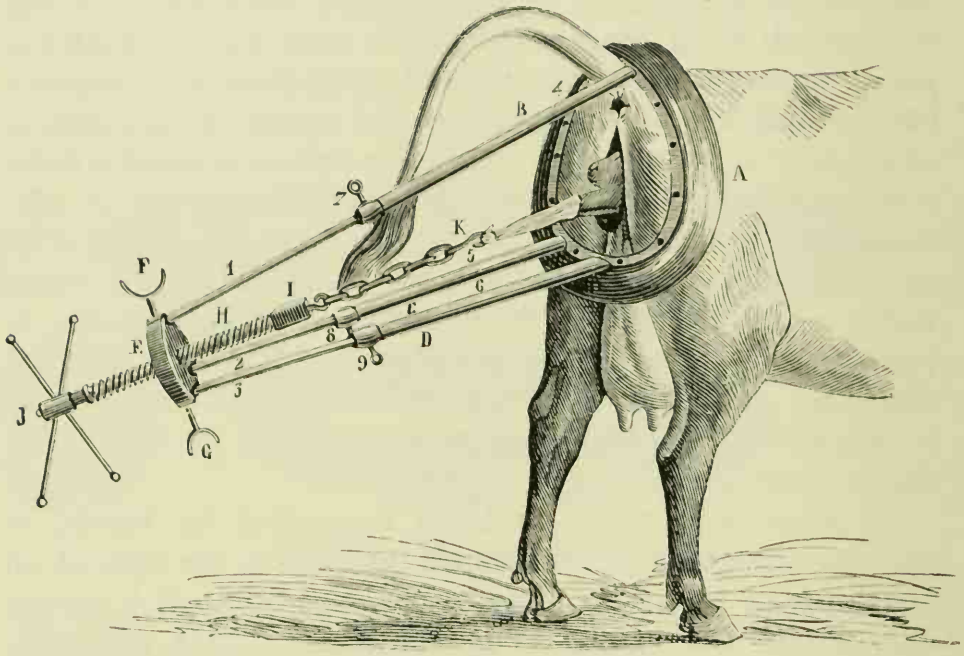

FIG. 144.—BARON'S OBSTETRIC MACHINE. (SAINT-CYR.)

collar enters one of the openings in the flange of the female screw (E); a small thumbscrew (7, 8, 9) secures the two portions of the stalk. The female screw is of iron or copper, the flange being of wood, and its circumference provided with two handles to hold it firmly when the machine is in use. The male screw (H) is of iron, and screwed to the right; one extremity articulates with the turning-hook (I); it is screwed in the contrary direction to the principal portion, so as not to become unscrewed during the operation; the other end has a four-branched windlass which can be removed at will.

To use the machine, the animal is made to lie; the cords

are attached to the fœtus in the usual manner; the windlass handle is put on its place; the screwed stalk (H) is introduced into the female screw to about as far as J; the collar is applied to the animal's croup, and the three long stalks are fixed—one end in the collar, the other in the flange. An assistant keeps the machine in equilibrium by placing one of his hands on one of the forked handles of the flange, while the other handle rests firmly on the ground. Another assistant, the cord attached to the fœtus being fixed in the hook at the end of the chain (K), slowly turns the windlass in such a direction as will bring the extremity of the stalk (I) towards the flange, while the operator superintends the extraction. It will thus be seen that a strong traction is exerted on the fœtus, while a proportionate pressure is transmitted to the croup of the parent through the three long rods—the machine producing extension and counter-extension at the same time, while it also allows a sustained traction to be obtained—without jerks or checks, and as powerful as may be desired.

This machine has been well tested in France, and received the highest praise.

In conclusion, it may be said that mechanical traction is preferable to that produced by manual power, inasmuch as it is slower, more regular, its action is more sustained, and it is more powerful and efficacious, without imposing increased strain on the parent or fœtus. Manual traction is unsteady and jerking, especially when several men are pulling; all the men do not pull alike or at the same time; therefore even during traction, however steady it may aim to be, the strain varies, as men soon become fatigued; whereas the machine can maintain the traction for any length of time without increasing or diminishing it.

One of the objections urged against machine traction is that its direction cannot be so easily varied upwards, downwards, or to one side or the other, as manual traction. But this is a very trifling objection, and it may be nearly, if not altogether, overcome by making assistants press against the cord or cords, so as to give these the necessary direction.

When powerful traction is required, whether it be manual

or mechanical, great attention is necessary in guiding the fœtus through the genital canal, so as to prevent injury to the parent. The traction should cease in the intervals between the labour pains, and the efforts ought not to be continuous; the animal should be allowed intervals of rest, and time be given for the genital canal to dilate and adapt itself to the passage of the fœtus. Severe and injudicious traction may be productive of the most serious results. Even when the operation is nearly terminated, care will be requisite in order to prevent inversion of the uterus. This accident may be obviated by careful manipulation and abundant injection of emollient fluids.

CHAPTER IX

EMBRYOTOMY

Embryotomy, or *embryulcia*, is the name given to every operation which has for its object the reduction in volume of the fœtus at parturition, by mutilating or dividing it, so as to allow it to be extracted by portions when it cannot be delivered whole. It is a generic term for a number of operations very different in their character, and performed on the fœtus either while it is wholly retained in the uterus, or more or less engaged in the genital passage.

The operations may be practised on various parts of the young creature—head, limbs, or body—and they facilitate the removal of one or more parts, so that the remainder can be removed from the uterine cavity.

The conditions which generally require recourse to embryotomy have been indicated. They are—*Deformities of the maternal pelvis*—either congenital or acquired, constitutional or accidental—which prevent extraction of the intact fœtus, this condition being, however, very rare in animals; *hysterocele; disproportion between the size of the fœtus and the genital canal;* certain kinds of *monstrosity;* particular *malpresentations* and *malpositions* of limbs or body, as well as *irreducible distortions* of the fœtus; *death of the fœtus*, when its retention in the uterus has given rise to intense emphysema, which hinders delivery; certain *diseases of the fœtus*, as hydrocephalus, ascites, œdema, etc. Indeed, embryotomy is indicated in every case when parturition cannot be accomplished by the other measures already mentioned, without seriously compromising the life or future usefulness of the parent.

Division of the fœtus is very often a heavy and fatiguing

task; and it may be remarked that, however easy it may be to lay down rules and give directions as to how the operation should be conducted, only those who have had experience of it can testify that it is much easier to write and to speak than to act, and that some of the manœuvres so complacently recommended by those who have but little knowledge of the practical part of veterinary obstetrics cannot be carried out.

The fact that only one hand can be employed in the uterus, that this organ is applied close to the fœtus when the "waters" have escaped for some time, that the membranes are adhesive and cling to the fingers, and that the flaccid tissues of the young creatures glide away from the cutting instrument—as they can only be rendered tense in certain circumstances by the cords or crotchets—all this testifies that, combined with the straining of the mother, the removal of the fœtus by instalments in the larger animals imposes a severe strain on the veterinary surgeon's physical and mental powers.

It must be stated that embryotomy cannot be restricted to definite rules which shall be applicable to every case; the operation must vary according to circumstances, and these are often of the most diverse kind. In very many instances, before the veterinarian is called in, rude and misguided hands have greatly complicated the case, and caused so much injury and swelling to the maternal organs that the difficulties are increased manifold.

But, as in everything else, there is a right way and a wrong way of operating, apart from the collateral difficulties of the operation; and though no fixed rules can be laid down for every case which requires embryotomy, yet there are directions, based on the results of practical experience, which afford a general and trustworthy summary of the most important points to be observed—by the young practitioner more particularly. These directions will now be alluded to in treating of the incision, excision, or ablation, of those parts of the fœtus which are selected for operation—these being the head, limbs, and body. But the instruments in actual use, or which are recommended for performing embryotomy, must first be noticed.

Embryotomy Instruments.

The performance of embryotomy necessitates the use of surgical appliances for the division, puncture, or removal, of certain parts; and as these operations have to be effected either in the genital canal or in the cavity of the uterus, the manipulation of cutting instruments in such a confined space by one hand, under all the disadvantages of distance from the operator, the struggles and paralyzing straining of the mother, and without the aid of vision to guide and direct, renders the task peculiarly difficult and dangerous. These difficulties and dangers have stimulated the inventive faculties of veterinarians for a long time, in devising instruments by which they might operate quickly and safely, and so obviate fatigue and danger to themselves, and exhaustion and risk to the parturient animal.

It is needless to remark that many of these instruments have never come into general use, either because they did not fulfil the requirements claimed for them, or because they were too complicated or expensive. Sometimes, also, prejudice rather conflicts with the introduction of any novelty in this direction, while long experience often enables the practitioner to achieve the desired end with instruments which would be useless, if not dangerous, in the hand of a less expert obstetrist.

So it is that, for nearly all cutting operations, an ordinary pocket-knife or bistoury is sometimes the only instrument employed, the operator being satisfied if the spring is sufficiently strong to prevent the blade shutting up in the handle when it is used in the uterus. Rainard preferred an ordinary knife, with a blunt point and a convex cutting edge; others use a bistoury caché. Even small pocket-knives of various sizes are utilized for this purpose, and one of Mr. Cartwright's embryotomy knives is not unlike a gardener's large pruning-knife. In the use and preference for knives, much must depend upon custom and the expertness of the operator.

Nevertheless, convenience, safety, and the absence of long experience, demand that proper instruments be devised for this

operation. One of the earliest to introduce a convenient and efficient embryotome was Günther, who in his work, published in 1830, figures an instrument which is fixed on the finger by a ring, the cutting edge of the blade—which is about 2 inches long—being somewhat concave. This embryotome has been slightly modified in various ways by different practitioners, sometimes having two narrow rings, so as to grasp more of the finger, at other times having in addition a small button on the back of the blade for the finger to press upon, while the blade itself has been made more curved, straighter, longer,

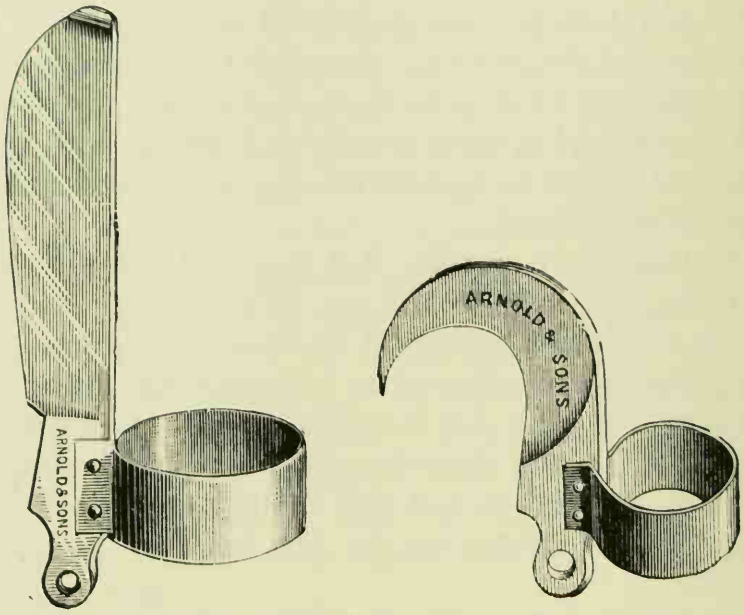

FIG. 145.—FINGER EMBRYOTOMY KNIVES.

or like the blade of a fleam. This instrument is the prototype of the ring scalpel invented by Dr. Simpson, of St. Andrews, for opening the head of the human fœtus. An improvement in this instrument is having a hole at the opposite end of the blade (Fig. 145), through which a piece of cord or tape can be passed and tied round the wrist to prevent the knife slipping from the finger and falling into the cavity of the uterus. Indeed, this is a wise precaution with all the short instruments introduced into the genital organs, as the contractions of the uterus, struggles of the animal, and the position of the hand, as well as the slipperiness caused by the presence of mucus, etc., only too often render the hold of the

instrument very insecure. The middle finger of the operating hand is passed through the ring, and the other fingers enclose the blade, which is in this way safely conveyed to the part of the fœtus which is to be incised. The finger-knife is the most useful instrument in embryotomy.

Günther also introduced another form of embryotome, which has likewise continued in use, and has been more or less altered or improved in shape. This consists of a blade that can be made to slide out and in a handle by the thumb of the hand holding it. It can therefore be introduced into or

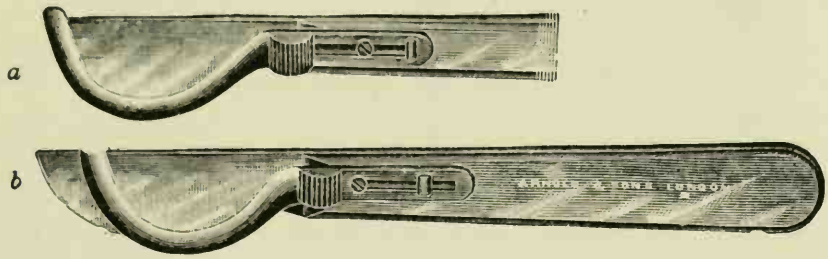

FIG. 146.—GUARDED EMBRYOTOMY KNIVES WITH SLIDING GUARD.
a, Closed ; *b*, open.

FIG. 147.—GUARDED EMBRYOTOMY KNIFE WITH SPRING SLIDING BLADE.

withdrawn from the genital passage without risk of injury to the maternal organs.

Another kind of embryotome is one not unlike an ordinary large scalpel, on one side of which glides a blade-guard that can also be moved backwards or forwards by the thumb of the hand that holds it. This is a very convenient knife (Fig. 146); there is also a similar embryotome, projected from the handle by pressure of the finger on a button when the incision is to be made, and which is perhaps preferable to any others. Unsworth's embryotome is somewhat similar, the blade being projected from the side of the handle by means of a spring pressed upon by the finger. One great difficulty with all these guarded embryotomy knives is to manipulate them—*i.e.*, close or open them within the uterus.

A long embryotome fixed on a handle and about 30 inches in length, is sometimes very serviceable (Fig. 149); the blade is semicircular, the concave border and point being very sharp. This instrument is extolled for its usefulness in cutting through the muscles subcutaneously, and especially in separating the limbs from the trunk. A probe point to

FIG. 148. —UNSWORTH'S SPRING EMBRYOTOME.

the embryotome allows it to be more easily manipulated without danger to the uterus. It may even be employed to cut through the ribs during evisceration, or through the pelvic bones.

Subcutaneous embryotomy is at times very necessary, but after the skin has been incised great difficulty is often experienced in separating it from the textures beneath, by

FIG. 149.— LONG-HANDLED EMBRYOTOME.

FIG. 150 —LONG-HANDLED PROBE-POINTED EMBRYOTOME.

tearing through the connective tissue. This is found to be the case more particularly in amputating the shoulder, when the fingers become fatigued in trying to pass them beneath the skin. To facilitate this part of the operation, different-shaped spatulas have been devised, which do the work of the fingers in liberating the skin from the parts it covers. One of these spatulas used by Cartwright consists merely of a thin but rigid blade of iron, about 7 inches long and one or one

and a quarter inch wide, the edges being smooth and rounded, and one end fixed in a wooden handle.

Carsten Harms employs a double spatula about 3 feet in length; the blade at each end is about 1 inch wide and 2 inches long, the intermediate portion being simply a round

Fig. 151.—De Bruin's Spatula.

Fig. 152.—Carsten Harms' Spatula.

Fig. 153.—Obstetric Chisel.

rod about half an inch thick; one end is a little bent to one side (Fig 152). This instrument can be used with both hands, and is more firmly held than a one-hand spatula.

Ungefrohrn proposes another but somewhat differently shaped spatula. This measures about 25 inches, the stalk

being about three-eighths of an inch thick, and the blade 2 inches long and somewhat crescent-shaped; the convex border is most useful in raising the skin, particularly in parts where the connective tissue is close and resisting. The blade must be pretty strong, and slightly convex on one side, concave on the other. The other end has a wide eyelet as a handle.

The section of bones, though not often necessary, is nevertheless sometimes required to be made, and it is found to be no easy matter—with the larger bones especially. For this purpose chisels, saws, and forceps, have been proposed and employed. A very simple and effective bone-chisel is made of the best steel, and including the handle it is about 32 inches in length; the chisel portion is a little more than 2 inches long, and one and a half inch broad; only the middle portion at the end is sharp, the two corners, which project a little, being blunt and rounded, as are also the sides. The edge may be made concave or angular. The chisel is applied to the desired bone by the operator, and an assistant drives it through the tissue with a mallet.

Marggraff's "Stemmeisen," or chisel, is not unlike a joiner's chisel in shape; the instrument itself is 7 or 8 inches long, and at its cutting edge (end), which is very sharp, it is one to one and a quarter inch broad. The sides are well rounded, and the instrument gradually tapers as it reaches the handle, into which it is fixed. This handle is a round piece of hard wood about 3 feet long and about 2 inches in diameter, with a ferrule at the end into which the chisel is fixed, as in the ordinary carpenter's chisel. The cutting end of the instrument is carried by the right or left hand to the part of the fœtus to be incised, while the handle is held by the other hand. The two hands can in this way be employed, that in the uterus guiding the movements of the chisel, while that holding the handle applies the necessary force. This simple instrument has been found most serviceable in dividing the vertebræ, or when the head of the fœtus had to be bisected, dividing the head, or, in double-headed monstrosities, the two heads; as well as slitting up the skin.

For the same purpose a saw has been proposed. Cartwright's saw consists of a stalk (of iron), 16 inches in length,

the saw 4 inches long, and the handle 6 inches. The saw-blade should be of the same thickness throughout, the end and back being well rounded and smooth. Small finger-saws are used, but are not very efficacious.

A surgical chain-saw, or sector, may be successfully employed. It is about a foot in length, and an inch wide. Each end has a ring to which a cord is attached, and to the cord may be fixed a short, transverse wooden handle (Fig. 154). The chain-saw has the advantage of being perfectly flexible, and can therefore be passed around bones, joints, etc., and the necessary movements performed in cutting through these—by pulling alternately at each cord—without endangering the

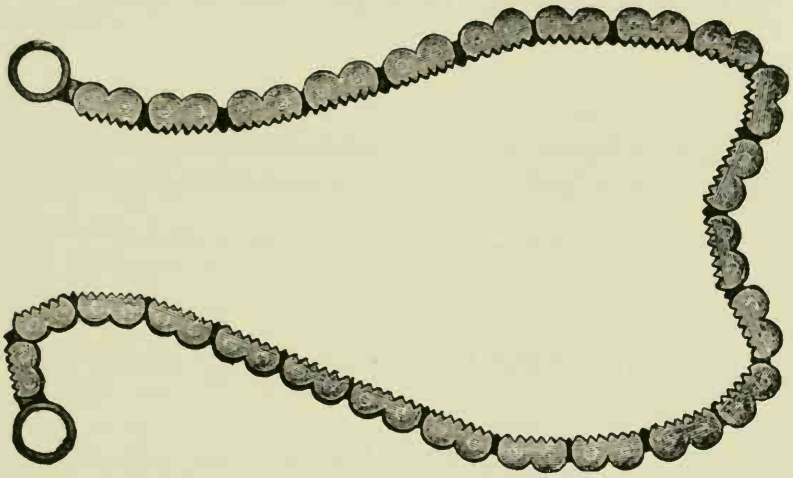

FIG. 154.—PERRSON'S PARTURITION SAW.

organs of the mother. One hand of the operator must, of necessity, guide the saw and ascertain its progress.

A very simple and useful instrument for effecting the same purpose as the chain-saw is Bowden wire. It is especially useful for cutting through limbs and is now frequently used for this purpose in the mare and cow by many practitioners to the exclusion of all other methods. The wire is looped round the limb of the fœtus, the two ends crossed outside the dam, and by a sawing motion the work is rapidly accomplished. With this method, as with the chain saw, there is no flap of skin left to cover the bone and protect the uterus, but the danger from this cause is not great. Care has to be taken not to injure the vaginal wall during the sawing process. An instrument designed to avoid the latter defect has recently

been introduced. With this instrument a thin plaited wire is used like the Bowden wire. The instrument consists of two steel tubes, each 2 feet 6 inches long, held together by rigid stays. The tubes are essentially protective and enclose the wire behind the loop. The wire is passed round the part of the fœtus to be sawn off in the genital passage, and each end passed through one of the tubes from the funnel-shaped extremity backwards. The proximal end of the instrument is then introduced into the genital passage until it abuts against the fœtus at the part to be operated on and maintained in position there. The ends of the wire projecting from the distal extremities of the tubes are then fixed to thumb-screws so that they can be moved by hand

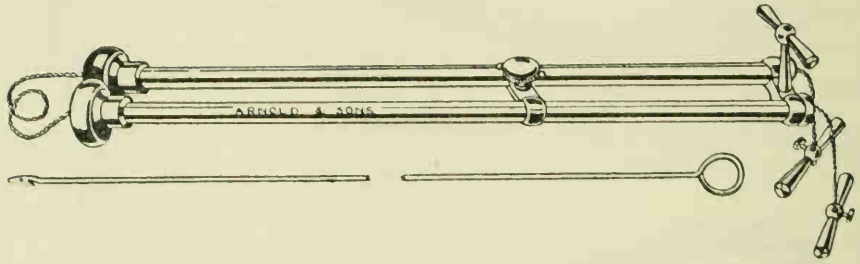

Fig. 155.—Embryotome (Arnold and Sons).

like a saw. The instrument has several advantages. It protects the genital passage against injury; it allows of the loop of wire being adjusted at various angles, and prevents the wire loop from slipping. It is very effective and has been used with success in detaching the limbs at the shoulder and hip, as the case may be, and even in the removal of the head (see Fig. 155).

Bone-forceps might be used advantageously. They should be made with the jaws bent, so that the cutting edge would be concave, and they should be made sufficiently strong in jaws and handles to cut through the largest bones.

Some large and elaborate instruments, built on the plan of an ecraseur, have been devised for the same purpose. Such an instrument is the Pflanz embryotome. It is rather cumbersome and expensive. The chain is applied round

the part of the fœtus to be amputated, and then adjusted and tightened by a rack and pinion arrangement. It cuts through the softer tissues, and even through bone.

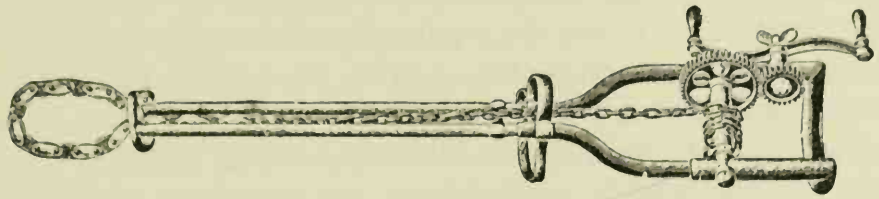

Fig. 156.—Pflanz's Embryotome.

From its appearance one would suppose that it is rather difficult to fasten to many parts which might require amputation.

In the foregoing, allusion has only been made to the instruments which are generally approved of; many more might have been described, but no particular advantage could have been derived by doing so. A multitude of instruments can only be embarrassing to the veterinary obstetrist; besides, it must be confessed that too little attention has been devoted to the perfecting of those already in use, or to devising others more simple and efficient to supplant them. There is here a wide field still open for those who desire to cultivate a most important department of veterinary surgery.

Preliminary Arrangements for Embryotomy.

There is not much to arrange before commencing embryotomy. The operator is supposed to have made an exploration of the genital passage, and to have ascertained the state of affairs; he may even have attempted everything possible in the way of extraction and failed. Being satisfied that nothing remains to be done to preserve the life of the parent but removing the fœtus piecemeal, he has to decide, from the nature of the case, how this is to be effected.

The animal must be detached from the manger or rack, and kept, if possible, in a standing attitude, this position being the one best suited for such an operation, or it may be tied

by the head to a stake by a rather long head-rope. A rope or, better still, a rug or blanket, should be passed round the hind-quarters, a little above the hocks, the ends being held by assistants standing towards the shoulders of the animal. This precaution is required to steady the creature, to keep it in a standing position, and to assist it in resisting the traction generally employed in removing the fœtus. It may be necessary, if the animal is much exhausted or suffering much pain, to administer a stimulant, or an anodyne draught, according to circumstances.

CRANIOTOMY OR CEPHALOTOMY.

Every operation which has for its object the diminution in size of the cranium, when that part offers an obstacle to the passage of the fœtus, is designated by these names. Hydrocephalus is the condition which most frequently calls for the operation in the larger animals, though certain malformations and monstrosities, and even an exaggerated volume of the head of the fœtus in the bitch or cat, may also require it.

Craniotomy comprises several distinct operations, which may be performed independently or simultaneously. These are *simple puncture, incision*, or *crushing* of the cranial parietes (*cephalotripsy*).

Puncture of the Cranium.

In order to allow the escape of fluid from the cranium—as in hydrocephalus—and thus permit the birth of the fœtus, a simple puncture is often all that is necessary. The fluid having escaped, the thin fragile bones of the cranium readily collapse from the pressure they undergo in the pelvic cavity, so that the head and body can be removed by traction.

Supposing the presentation to be anterior, it is first necessary to fix the head, unless it is firmly wedged in the passage; this fixation may be effected by using a head-stall, Schaack's head-stall forceps, or even a cord on the lower jaw, exercising sufficient traction on the cord to prevent the head from slipping from under the hand of the obstetrist during the operation.

The head may be punctured by a scalpel, straight bistoury,

finger-knife, or even the finger in certain cases. If a long-bladed instrument is used, there is sometimes a good deal of risk, so far as the maternal organs are concerned; it is advisable to wrap twine, tow, or tape, around a good portion of the blade towards the handle.

The best instrument, if it is at hand, is a long, medium-sized trocar and cannula, the end of the latter fitting closely on the stalk of the trocar, which should be very sharp. It is introduced safely into the genital canal by drawing the point sufficiently far back into the cannula to be entirely concealed. This end is then seized between the fingers and thumb in such a way that the index-finger extends a little beyond the extremity of the cannula, the other three fingers holding it in the palm of the hand, while the right hand sustains and guides the instrument Should the trocar not fit the cannula tightly, the play between the two renders their introduction somewhat difficult, and the point may glide through and wound the operator. The trocar may in such a case be pushed quite through the cannula, and the point fixed in a cork, which can readily be knocked off by one of the fingers when the instrument has reached the head of the fœtus. Having arrived at this part, the proper spot for puncture is selected, and then the instrument is applied to it—perpendicular to its surface, if possible, to prevent slipping. The trocar is made to penetrate slowly by a slight rotatory motion from side to side, and when all resistance ceases the cranium is perforated. This perforation should not be made at the sutures, if they can be avoided, as they overlap and close the opening. The cannula is now held firmly in its place by the left hand, the trocar is withdrawn by the right, and the fluid escapes. The instrument should be sufficiently long for the end to be near, or even outside the vulva, when the point is on the cranium of the fœtus.

There is no difficulty in performing this operation when the head presents first, even though it should not have entered the inlet, so long as it is easily accessible to the hand. With the posterior presentation, however, the operation is troublesome, as, owing to the body of the fœtus occupying the passage, it is extremely difficult to pass the hand armed with the trocar so far as the head. Nevertheless, it may be

accomplished in many cases by patience and tact. There is no reason why the trocar and cannula should not be passed through the mouth of the fœtus in some cases, and made to penetrate the cranium at the base of the skull, when the frontal region cannot be attained. If the head cannot be reached in this presentation, then the body of the young creature must be divided, and the parts removed until the head can be manipulated.

Craniotomy

Craniotomy is resorted to when puncture has not sufficiently reduced the size of the head. It is an operation of great antiquity in human obstetrics, and various instruments have been introduced to facilitate its performance; but very few of them have been utilized in veterinary obstetrics, and, indeed, for the larger domesticated animals they are of no use. A simple straight or curved bistoury, embryotome, such as a finger embryotome, or the long-handled embryotome, bone-chisel, or saw, may one or all be employed, according to circumstances. It cannot be denied, however, that the operation is very difficult to execute, and is not without serious danger for the parent. The *cephalotribe* and *cranioclast*, so useful in human obstetricy, cannot be employed to advantage with our animals, it would appear.

Hurtrel d'Arboval recommends that craniotomy be performed with a convex probe-pointed bistoury (sharp on the convex border), the middle of the cranium being incised then the fingers compress the bones, and so effect delivery.

Rainard advises two incisions on each side of the head, in the parietal region. Carsten Harms states that when the head is an obstacle it should always be crushed, if possible, the bones being broken beneath the skin. Sometimes it is sufficient to remove the lower jaw; and in order to effect this, the jaw is first fixed by a cord, the skin is then cut through on each side—from the commissure of the mouth to the temporo-maxillary articulation, the masseter muscles and the ligaments being divided. A transverse section of the skin is now made between each joint, the finger separating it, and then, two or three assistants pulling at the cord, the jaw is removed. If

it is the transverse diameter of the head which forms the obstacle, the division must be longitudinal, and great service may be derived from the use of the bone-chisel. As much of the skin should be left as possible, in order to cover the jagged ends of the bones.

With the smaller animals, puncture and craniotomy are not at all difficult operations, the bones being fragile and easily perforated or crushed. Forceps may be of great assistance in the latter operation.

DECAPITATION AND DECOLLATION.

Decapitation, an operation which consists in separating the head completely from the body, so as to allow these parts to be removed one after the other, is not very often required; and fortunately so, as it is not without great danger to the parent. More frequently the head is partially removed, the fore-limbs amputated, or evisceration of the chest or abdomen —or both—practised, rather than resort to decapitation.

Decollation is necessary when the neck is distorted and cannot be straightened, and has to be divided at the point of curvature, the head and portion of neck attached to it being then extracted.

Decapitation is indicated when a double-headed monstrosity —monosomian or sysomian—is presented, and in certain irreducible malpositions of the head or limbs, especially in heifers, when the head of the calf is in the genital canal, and can neither be advanced nor pushed into the uterus.

The operation is more or less difficult, according to the situation of the head—if entirely in the uterus or fixed in the passage, or if it is at, or can be brought near or beyond, the vulva. In the latter case it is easily accomplished, although, except in the case of double monstrosities, it is rarely very useful, as when the head is in this situation it is not an obstacle to birth, and its removal deprives the operator of a most powerful means of exercising traction on the parts which are firmly retained in the maternal organs. When wedged in the canal, however, the head may prove a troublesome obstacle to the performance of those manœuvres necessary

for the reduction of other parts; as it may not be possible either to advance or repel it, nor yet to pass the hand between it and the pelvic walls to search for a deviated limb, for example, or to bring that limb into a proper position.

The passage must therefore be freed from the obstacle, and this can be accomplished in various ways, the most common of which is as follows: The fore-limbs, if present, are corded and pushed as far towards the uterus as possible; then the head is secured by cording the lower jaw, a pointed hook fixed in each orbit, or a head-collar over the head if it can be placed. Four or five assistants now pull at the head by these appliances, so as to bring it as near the vulva as circumstances will permit; while another assistant keeps the labia apart, in order to expose as much of the head as he can, and prevent injury to the organs of the parent. The operator, with a convenient knife (the curved finger-scalpel is very useful), incises the skin around the neck—first one side, then the other—close to the occiput, passes his fingers between it and the muscles beneath, and pushes it well back on the neck; the assistants, pulling at the head at the same time, facilitate this separation. A few cuts now divide the soft tissues down to the vertebræ, and nothing more remains to be done than to produce disarticulation by vigorous traction and a twisting movement of the head at the same time; the ligaments gradually yield and tear, the head extends and at last comes away, and the body of the fœtus recedes more or less suddenly into the abdominal cavity. If the limbs have been previously secured, they are brought into the passage by the cords attached to them; or if they are not so accessible, they must be sought for in the way already indicated, and delivery completed, care being taken to cover the exposed bones of the neck by the surplus skin, while the fœtus is being brought through the passage.

Another method is to make an incision through the skin across the forehead, in front of the ears, and to separate it by means of the fingers or spatula, as far as the occipital articulation. The knife divides this joint, as well as the soft tissues around it, and particularly the ligaments; traction will bring away the head. The upper part of the neck is covered by the loose skin—which may be fixed there by

ligature — and directed into the middle of the passage. Crotchets should now be placed on the bodies of the vertebræ, or even on the ribs if they can be reached; as the limbs do not offer sufficient resistance when they alone are pulled at, neither do they bring the body fairly into the passage. Traction should be made on the sternum, not the withers, as the latter ought first to enter the inlet.

A third method consists in removing the lower jaw, and excising the head from below. Or this incision may be practised from the mouth, the chisel being used to divide the vertebræ, after the cheeks, masseter muscles, and soft tissues behind the lower jaw, have been cut through.

Amputation may also be readily and safely effected by the Pflanz embryotome or Arnold's embryotome (p. 410).

Decapitation, under the most favourable circumstances, is often a long and fatiguing operation, as the greatest care has to be observed in order to avoid injuring the parent; but this fatigue and anxiety are vastly increased when the head is deeply buried in the passage or the uterus. Then the hand—moist with the fluids of the genital organs, embarrassed by shreds of the fœtal envelopes, hampered by the presence of the limbs, compressed and paralyzed by the uterine contractions—can scarcely hold and guide the cutting instrument, or distinguish what belongs to the fœtus and what to the mother, and has scarcely strength to divide the tissues, which are all the more difficult to cut by reason of their softness. It will readily be understood how such an operation must be difficult for the operator and dangerous for the mother. It might also be deemed impossible, if veterinarians had not attempted it and succeeded, though the majority of them have said but little as to their mode of procedure.

It is always preferable, if possible, to remove one of the fore-limbs, as this is easier, quicker, and less dangerous.

But decapitation must sometimes be performed, and then the above instructions will be found useful.

In the case of double-headed monstrosities, the saw and bone-chisel, or a pair of strong bone-forceps, will be valuable. When the head of the fœtus is retained in the uterus, and bent back towards the shoulder or flank, then it may be decided to amputate the head and a portion of the neck.

Disarticulation may be commenced at the most convenient part of the convexity made by the bend of the neck, cutting through the soft tissues down to the vertebræ on that side, then on the other; then sawing or chiselling through the bones, and afterwards using the crotchets carefully. Williams prefers in such cases to amputate the fore-limb rather than the head and neck.

AMPUTATION OF THE LIMBS.

When the limbs are so deviated that they cannot be straightened, or when by their presence in the genital passage they prevent the necessary manœuvres for the adjustment of other parts of the fœtus, then it may be necessary to amputate or disarticulate one or more of the extremities. Some of the indications for the operation have been referred to on various occasions; they include all those fœtal monstrosities which have supernumerary limbs that require removal before delivery can be effected; those cases in which the fœtus is exaggerated in volume, either normally or through having become emphysematous *in utero;* those complicated mal-presentations—such as the abdominal, hock, thigh, etc., and certain deviations of the head and neck in the anterior presentation. In the latter it is well to hesitate before deciding to remove the limbs; for if it is true that their ablation allows more space for manœuvres, and more facility for adjusting the head, it is not less true that, should these manœuvres fail, by the loss of the limbs we are deprived of a powerful means of traction.

One or both of the fore or hind limbs may be required to be amputated, according to circumstance. In the earlier days of veterinary science the obstetrist was content to pull at the limb of the fœtus which he wished to remove, either by mechanical or manual power, until it was torn off by brute force. Fromage de Feugré mentions that Texier had in this manner torn away the limbs of many foals which he could not extract, the separation of the limb always taking place between the chest and scapula, by rupture of the muscles uniting these two parts; and he asserts that by this procedure

he was able to save many mares, though he says nothing as to the suffering of these before the limbs could be torn from the body.

Subsequently it was discovered that the skin offered most resistance to this kind of avulsion, the muscles and ligaments being much more easily torn. Then the knife was employed to incise the skin, and thus get rid of the chief difficulty. On the Continent, in amputating a fore-limb, for instance, the skin and muscles were divided as near the shoulder as possible, and the bones, united by their ligaments and covered by the skin, separated by traction. Skellet, in his crude and imperfect work published in 1807, writes: "Take a sharp knife, and cut from the point of each shoulder of the calf to the muscular or thick part of the fore-leg; then cut round it, so as to enable the operator to skin the upper part of the shoulder. A knife is then to be conveyed between the shoulder and brisket, so as to cut the muscles which unite them. When so done, the leg and shoulder may be easily pulled off from its body. The other fore-leg, etc., is to be taken off in the same way." But the subcutaneous method of excision was greatly facilitated by the directions published in Günther's work in 1830, and also by the publication of the procedure of Huvellier in the same year; while the parent was protected from some of the dangers and pain which attended the old plan. Since the introduction of this method, it has been adopted by every obstetrist of note, who has either kept to the original procedure, or modified it to suit his own fancy or convenience.

Amputation of the Fore-Limbs.

In order to amputate a fore-limb, it must be more or less advanced in the vagina, or partially beyond the vulva. So that, if it is still in the uterus, it must first be removed therefrom and brought into the canal. If both limbs are to be removed, they must be secured by cords around the pastern in the ordinary manner, the cord of the one which is to be first excised being pulled at by two, three, or four assistants, so as to draw it as near, or as much beyond, the vulva as possible. Another assistant then keeps the labia wide apart,

in order to allow the operator more room. A circular incision is made above the fetlock, or, better still, the knee, taking care not to go deeper than the skin. From this incision, gliding his hand into the vagina, along the limb, the operator gradually makes a longitudinal one, extending higher up as the leg becomes elongated by the traction.

Some practitioners make this incision on the inner aspect of the limb, others on the outer side. The latter side is preferable, because there is less danger of wounding the maternal organs, and it may be more convenient for the operator. But this is a matter of minor importance; it is more necessary to be careful in incising the skin beyond the articulations, so as not to divide the ligaments of these, as this might lead to the limb being torn away at the wrong place; no such precaution is necessary with the muscles.

This longitudinal incision having been made, the skin is separated from the structures beneath, either by means of the fingers or the spatula, pushing it up towards the shoulder as it is detached, until at length, as the leg becomes stretched, the incision and the detached skin are as high as the shoulder The dissection being then deemed sufficient, and the limb being only retained by the muscles which attach it to the thorax, the operator, either by his hand or the crutch, makes pressure on the fœtus, while the assistants are ordered to pull energetically at the cord on the pastern, and in a kind of jerking manner. Soon slight crackling sounds are heard, the muscles are rupturing and giving way, and in a very short time the entire limb—scapula and all—is removed.

The removal of one limb usually leaves a considerable space in the genital canal, and this allows delivery to be completed. Sometimes, however, and particularly when the head is deviated towards the flank, it is necessary to remove the other limb; and this, when effected, permits the head to be sought for and rectified, version accomplished, etc., according to the requirements of the case.

Some practitioners operate in a somewhat different manner to the foregoing. Lecoq, for instance, commences his incision at the upper part of the shoulder, brings it down over the head of the humerus, on the side of the forearm, and as far as the middle of the cannon, where he makes his circular

incision; the skin is separated from this part upwards. In some cases this procedure may be preferable to the other, and it certainly is less dangerous for the parent; but it sometimes happens that the shoulder cannot be reached.

Günther pushed back the fœtus as far as possible by means of the crutch, with the finger-scalpel divided the skin before and behind the scapula, then across—below and above; then cutting through the pectoral muscles, and extracting the limb. Cartwright operates in a similar manner to Lecoq. He first has a leg drawn out, and divides the skin as far as possible; or he introduces his hand, containing a knife, as high as he can on the side of the scapula, and makes an incision thence down the whole length of the limb to the pastern bones; the skin is separated by the fingers or spatula as far as possible from the entire leg, and the transverse pectoral muscles cut through. The limb is then disjointed, either at the pastern or fetlock, the foot being left attached to the skin, as it is afterwards found to be useful in the extraction of the body. Cords are fastened around the limb above the fetlock-joint and knee, and the cow being firmly tied by the head, the necessary force is applied, and the whole limb drawn away. He writes: "I have known, in some of these cases, the limbs to separate at the shoulder-joints, and yet the fœtus has been extracted—both from the mare and cow—with the shoulders attached, the points of the latter having, fortunately, not caught the edge of the pelvis. The great danger in these cases is, that the shoulder-joints may catch against the pelvis and thus prevent extraction."

Meyer and Williams recommend that the circular incision on the cannon be not made until the skin is detached above, as this facilitates avulsion.

It is well to divide as many of the muscles uniting the limb to the chest as possible, and also to apply counter-extension by means of the arm or crutch placed against the chest or opposite shoulder of the fœtus; this also spares the mother much of the pain and exhaustion attending extraction.

Amputation of the entire fore-limb, including the scapula, is a very useful operation in the most serious cases of dystokia; but there sometimes occur instances in which the

whole leg need not be excised, as when the legs are an obstacle rather from their length than their volume. This happens, as has been described, in the abdominal presentation of the fœtus, when the limbs so often render version difficult —all of them being perhaps in the genital canal, from which they cannot be advanced or pushed back. In these circumstances, disarticulation of the limbs at the knee or elbow joints is often practised, the latter being generally preferred; though it must be remembered that excision at this part can be but of limited value, and, in fact, is only useful in the presentation just alluded to, because it does not give so much room as removal of the scapula and humerus.

In the abdominal presentation with four legs in the vagina, Donnarieix lays down the following procedure: Three pieces of supple twine are got ready, as well as a strong cord. With the twine the pasterns of three of the limbs are firmly bound, while the cord is fixed on the limb which is to be detached, and confided to five assistants, who pull at the cord while the other limbs are pushed towards the uterus. The knee, then the forearm appear, and the lips of the vulva being kept widely separated, the operator makes a circular incision through the skin at this part; traction is again applied, the muscles tear, and gradually the joint is reached. The tendons and ligaments are cut, and the leg being twisted as it is pulled out, another cut of the knife finally removes it.

With the sheep or goat, amputation of the fore-limbs of the fœtus is very rarely indeed required, though, if necessary, it can be effected. The same remark applies to the bitch and cat.

Amputation of the Hind-Limbs.

When the fœtus makes a posterior presentation, and a hind-limb appears at the vulva, it may be necessary to amputate this limb; or with the hind-limbs flexed at the hocks, and so firmly wedged in the canal that they cannot be extended backwards, nor yet sufficiently bent to permit delivery—which is far from being rare in the mare—these joints are disarticulated.

In the latter case it is accomplished by passing a running noose round each leg, above the hock, and tying it firmly

there. Powerful traction made on one of the cords by four or five assistants will bring the point of one of the hocks to the vulva, the lips of which are separated, while the operator divides the gastrocnemii tendons and the lateral ligaments of the joint, so as to produce complete disarticulation. The tibia is then pushed into the vagina, the other limb is amputated in the same way, and birth is accomplished by pulling at both cords, which remain attached to the lower end of the leg-bone. If necessary, the bone-chisel, chain-saw, Bowden wire, or embryotome may be used to cut through the tarsus.

When the limbs are completely retained in the uterus at this presentation, the procedure recommended at p. 328 must be adopted. The following procedure has been recommended: A long incision is made through the skin and muscles behind the hip-joint; the hand removes all the muscles around the upper part of the femur, round which a cord is then fixed and pulled by two assistants, while the operator cuts through the attaching muscles and ligaments, especially the capsular ligament. In this way the joint is disarticulated, and a circular incision through the skin completes the task, as traction will remove the limb.

Edwards of Mold gives the following details of this method, which he recommends as specially adapted to the removal of the hind limb in breach presentations in the mare and cow: "Having located the hip-joint, I make an incision, starting 5 or 6 inches above the joint, and carry it right over the femoral head for another 4 or 5 inches, and cut through the muscles, the cotyloid ligament and all tissues, until the head of the bone and the rim of the acetabulum can be felt. It will now be found that there is quite a lot of 'play' in the movement of the head of the femur in the acetabulum, but the ligamentum teres binds it to its socket, and must be broken down, and for this I use a long, solid-shafted hook, shaped like a miniature shepherd's crook. I carry the crook end of the instrument, guarded in the left hand, on to the anterior side of the femur, just below the head and the trochanters, and press the end down and around the shaft, between it and the pelvic aspect. I now pull on the handle of the instrument (still keeping my left hand pressing down the crook) with a

sharp jerk or two, until I know that it is firmly fixed around the shaft of the bone. Still keeping my left hand on the head of the crook, I then get an assistant to rotate the instrument slowly at the handle, on its long axis.

"If one is operating on the off hind-leg, the rotation must be from left to right, and *vice versa* with the near limb, so as to lift the head of the femur outwards and upwards from the pelvis.

"If the first turn of the handle does not result in cleavage of the ligamentum teres and liberation of the head, stop the rotation, and press the crook deeper around the shaft so as to take a fresh hold, and then rotate. In a very strong calf, or in foals, it is well for the assistant who is doing the rotation to exercise a little backward traction at the same time, but usually a very little force is required, and that exerted by one man only, before, with a little 'scrunch,' the head of the femur pops up out of its layer, and a rope is passed around it below the head and trochanters. Before putting on the rope I generally use the knife and sever more of the muscles and the skin longitudinally with the shaft of the femur, until the latter is well freed. This I do because I have sometimes cut through my rope when doing this part of the work after roping the femoral head.

"A stick is now put on the rope end and traction is applied, when very quickly the head of the femur appears through the vulva, and the rest of the work is done 'extra vulvam,' and consists in slitting the skin longitudinally with the direction of the leg as the traction brings it outside. Traction is often slightly checked at the patella, but a circular or several longitudinal skin incisions on that region at once free it, for the process is much like skinning a rabbit. The skin may then be severed by a circular incision at the hook and the limb removed."

Williams advises removal of the hind-limb in the following manner: The hand introduced into the vagina or uterus makes a free incision with the knife into the perinæum of the fœtus, so as to allow the entrance of the hand into the fœtal pelvis. The sacrosciatic ligament is to be carefully incised. Then, with a bone-chisel, the shaft of the ilium, and later the ischio-pubic symphysis, is cut through. By manipulation with the chisel the innominate bone operated on is separated

from the rest of the pelvis, and the muscles detached from it by the fingers. A rope is now attached to the isolated piece of innominate bone, and assistants apply traction, while the operator tears through the resisting muscles with his fingers, and, if necessary, cuts them with the knife. He must also take care that the exposed edges of the bone do not injure the maternal tissues. The skin of the fœtus is cut through below the stifle. Sometimes the innominate bone becomes detached from the femur. In that case the rope is fixed to the head of the latter bone. Traction then brings away the hind-limb, while the operator pushes forwards the rest of the fœtus with his hand or a repeller. If the other hind-limb is to be removed, then the shaft of the ilium of that side must also be cut with the bone-chisel, and the remaining part of the procedure is as for the first limb.

It may be remarked that Carsten Harms recommends symphysiotomy to be practised on the fœtus when the buttocks present at the inlet, the symphysis pubis being cut through. By this means the two borders of the symphysis can be made to overlap, and the transverse diameter of the pelvis is thereby diminished. The finger-scalpel and spatula are the instruments he prefers. The chain-saw or bone-chisel might be advantageously used.

In certain kinds of monstrosity in which the posterior parts of the fœtus are double, or when the hind-limbs are in the vagina, and in consequence of the narrowness of the maternal pelvis, or width of the croup or haunches of the young creature, birth cannot take place, then amputation of the legs at the trunk may be necessary. Such an operation can be rarely required, however. It is performed in a similar manner to that for removal of the fore-limbs—subcutaneously. A cord is fastened to each pastern, and, one after another, the limbs are drawn towards the vulva ; a circular incision is made through the skin above the hock; then a longitudinal incision is carried as high as possible on the thigh, and the skin separated in the ordinary way by means of the spatula, always ascending towards the croup; the gluteal and other muscles attaching the thigh to the pelvis are cut across, and the limb is at last torn away by strong and sustained traction

Amputation of the hind-limb is a much more onerous and

fatiguing operation than the removal of the fore extremity. The skin adheres very closely to the subjacent textures, and more labour is needed to separate it from them; the muscles attaching the limb to the trunk are more numerous and powerful, and when they are cut through there remains the resistance of the pubio- and coxo-femoral ligaments (in the foal; the pubio-femoral ligament is not present in the calf). Harms estimates that, if three assistants can pull away a fore-limb, four men will not in every instance remove a hind one. However, the difficulties are not always insuperable, and many cases are on record in which the operation has been successfully performed.

After avulsion of the limbs, crotchets should be fixed in the cotyloid cavities or oval foramina, and delivery completed according to the directions already laid down.

DETRUNCATION OR DIVISION OF THE BODY OF THE FŒTUS.

When one half of the body of the fœtus has more or less passed through the pelvic canal, and the other half is retained, so that it is impossible to extract or return it, it is recommended to cut the trunk in two—*division* or *detruncation*. It has been shown that this retention may be due to malposition or malpresentation, excessive development or deformity of the hind-quarters of the fœtus, as well as ascites, anasarca, or emphysema (*physometra*).

If the hind parts are retained, and the head and fore-limbs are not much beyond the vulva—if so far—cords should be placed on each pastern and a head-stall on the head, and slow, gradual, but strong traction exerted on them, so as to expose as much of the body of the young creature as possible. This done, the operator, with a sharp bistoury, incises the body in a circular manner as close to the vulva as is convenient (the labia being kept well away by an assistant)—the incision commencing below, which allows the elongation of the spine; then the skin and muscles on the sides are divided. When the vertebræ are reached, the bistoury is passed between them, and as close to the loins as possible; slight pulling and twisting will then complete the bisection.

It is a good plan to incise the skin at some distance in front of the place where it is intended to divide the spine, and to separate and push it back over the portion of trunk in the genital canal. When the division of the body is effected, this superfluous skin is pulled over the remaining part of the trunk and sewn together, so as to enclose the latter completely, thus preventing injury to the parent during the subsequent manœuvres.

Should the hind-limbs be doubled under the croup in the passage, or should they still be in the uterus, they ought to be sought for and corded at the pasterns, the cords being given to assistants. Then vigorous pressure is applied to the divided end of the spine in the remaining part of the trunk, while the assistants pull until version is effected; extraction is afterwards easy. In some cases it is not necessary, nor is it always possible, to secure the hind-limbs before the trunk is pushed into the uterus, version taking place merely by the retropulsion; and sometimes when one limb has been found, there is much difficulty in discovering the other. In such a case, and when version cannot be effected, the limb which has been secured should be drawn towards the vulva and disarticulated; this will enable the operator to find the other leg.

When the fœtus is altogether in the uterus, division of the body is a formidable business, even when the hand can reach it and move about it easily; it is still more formidable, if not impossible, in large-sized animals when the fœtus can scarcely be touched.

When the fœtus is in the horizontal dorso-lumbar presentation, Saint-Cyr suggests that the maternal straining, if too violent, should be subdued. The hand, armed with a bistoury, is passed between the uterus and the fœtus, and the latter is cut down through the back to the vertebræ; then the knife is passed into the body between the last rib and ilium, and the flank cut through, another incision upwards reaching the under-side of the vertebræ—a hook fixed in the abdominal walls makes this region more tense and easier cut, while it brings it nearer the hand. A cord is now passed around the exposed vertebræ to bring these closer to the operator, who divides them with a knife or saw. The body of the fœtus is

then in two portions, the more convenient of which is first to be extracted, while the other is pushed out of the way. In extraction the crotchet and cords are employed; the first portion being removed, the second has to be found, secured, and got away likewise, care being taken to guard the maternal organs from injury by the exposed vertebræ.

If necessary, the body may be divided into more than two portions at the spine, and the ribs and sternum may also be removed.

In other presentations the details of the operation may have to be modified, but the principles are the same.

EVISCERATION.

When it is desired to reduce the volume of the thorax or abdomen, or both, the organs they contain are removed. This procedure is generally adopted when, after removal of one or more of the limbs, the body of the fœtus still remains fixed in the genital canal, as in sterno-abdominal and sterno-lumbar presentations. By it we obtain a considerable diminution in the dimensions of the body, more room for manipulation and version, and perhaps, next to the removal of the limbs, it is the most useful operation in embryotomy.

As we have said, evisceration of either of the cavities may be practised, according to circumstances. We shall therefore describe the mode of reducing the volume of both—thorax and abdomen.

Thoracic Evisceration.

This operation is sometimes practised in the anterior presentation when the thorax of the fœtus is too large, and may be performed independently of abdominal evisceration. The chest is emptied of its contents first, when the anterior part of the fœtus is in the passage. The head and limbs should be corded, and one of the latter removed. Should the head be an obstacle to the performance of the operation, it may be amputated; but if it is back in the uterus, then it may be left there. A strong scalpel with a long handle, the finger-scalpel, or any of the short embryotomes, may be used for the

purpose. It is passed carefully into the vagina until the hand reaches the breast of the fœtus, when the blade is thrust deeply into the chest, between the two first ribs, and as close to the spine as possible, cutting down towards the sternum and upwards to the vertebræ.

The knife is now dispensed with, and, the hand being re-introduced, the fingers are pushed into the chest and the two first ribs removed, thereby allowing sufficient room for the whole hand to enter the cavity. The lungs and heart are torn away from beneath the spine, and, with the thymus gland, removed from the uterus. The chest collapses a good deal, but if the fœtus cannot yet be extracted, the hand may be pushed through the diaphragm and the contents of the abdomen carried away through the chest.

Some operators, instead of opening the thorax in front, incise from two to five of the ribs close to the sternum, and pass the hand into the chest by the aperture so made. Others divide the ribs on both sides, and remove the sternum as well as the viscera. It will often be found that the contents of the chest and abdomen can be removed without cutting the ribs.

Abdominal Evisceration.

Evisceration of the abdomen may be effected, as just stated, through the thorax, by tearing away the diaphragm.

But in the posterior or abdominal presentations, and, indeed, in any presentation or position in which this region is accessible to the hand, eventration can be performed. Nevertheless, it is not always easy; on the contrary, it is sometimes most difficult and dangerous.

Either of the embryotomes used for evisceration of the chest may be employed for the abdomen.

The edge of the instrument is applied to the wall of the cavity, which is incised by drawing the hand towards the operator. Then the whole of the viscera are torn away, and, if need be, that of the chest also, through the diaphragm. This may even be carried out through the pelvis of the fœtus after incising the perinæum and sacrosciatic ligament.

CHAPTER X

VAGINAL HYSTEROTOMY

Vaginal hysterotomy consists in incising the indurated and inextensible neck of the uterus in such a manner and to such an extent that it will allow the fœtus to pass through the canal.

For this purpose the only instrument necessary is a strong probe-pointed bistoury or a bistoury caché. When the straining of the animal has propelled the cervix uteri towards the vulva, with partial prolapsus of the vagina, the operation is simple, as the eye can then aid the hand. All that has to be done is to glide the instrument into the os, and make the necessary number of incisions through the tissues composing the cervix, the situation and depth of the incisions depending upon the extent of the induration and the atresia.

In other cases there is no prolapsus of the vagina, which is quite soft and elastic. Then the left hand may be passed into it, and the index-finger being introduced into the os, draws the cervix towards the vulva ; the labia of the latter are separated by an assistant, and the operator passes the blade of the instrument—guiding it by the index-finger of the other hand —into the os, where he gradually and steadily incises the tissues.

When, however, the walls of the vagina are involved in the induration, this retraction of the cervix cannot be effected, and the part must be operated upon in its ordinary situation, the knife being carried carefully into the vagina, passed to the necessary depth in the os, and the incision made. Perhaps the bistoury caché is the best instrument for such cases.

It is rare, indeed, that one incision is sufficient ; generally from two to four are required, and it is better to have a larger

number than make them too deep: they certainly must not pass through the entire thickness of the cervix.

The situation of the incisions is a matter of some moment. The lower portion of the cervix should be avoided, in consequence of its proximity to the floor of the vagina, which is in immediate contact with the bladder and urethra. Should these be wounded, the results might be serious, if not fatal; and if the peritoneum is cut or torn during the passage of the fœtus, fluids and discharges will escape into the abdominal cavity and give rise to peritonitis. There is less danger in incising the upper part of the cervix, as the rectum is not so near; nevertheless, in induration there may be adhesions between them, and an accident is therefore possible, though it must be rare.

So that, if only two incisions are required, it is advisable to make one on each side of the cervix; and if four are necessary, to have them at each corner.

Horsburg recommends, if atresia is complete, to pass the finger or a blunt instrument into the os, then introduce a stout, sharp-pointed, curved bistoury about 4 inches long—dividing the stricture laterally by two incisions—always drawing the bistoury towards the operator; after which he is to introduce both hands, with the palms towards each other, and press them apart. "He will find the part immediately dilate to the proper size, and labour may go on naturally; or he may then proceed to extract the calf if labour has been protracted."

The object in making the incisions only to a comparatively slight depth, and not through the entire thickness of the os, is to prevent extensive lacerations of the organ during the passage of the fœtus. It will generally be found that these partial incisions will, with a little patience, admit the hand; this, being passed into the uterus, seizes the presenting part of the young creature, places it in a favourable position if necessary, and then begins to draw it gently into the os.

Sometimes with primiparæ in good health and strong, delivery is afterwards effected spontaneously, and this is the most favourable result; but in the majority of cases labour has been going on for a long time, perhaps two days or more, the parent is exhausted, and the uterine contractions are

either suspended or so feeble as to preclude all hope of their expelling the fœtus. The head and fore-feet must then be corded, and delivery accomplished in the ordinary way.

It is well to remember, however, that the traction resorted to must be judiciously employed. It should be moderate, gradual, and sustained, in order to allow the tissues of the cervix time to accommodate themselves to the eccentric pressure imposed on them by the advancing fœtus. To act otherwise is to incur the grave risk of lacerating the uterus beyond the possibility of repair, and is quite as reprehensible as making deep incisions.

Prognosis.—This operation is attended with very serious risk. Saint-Cyr notes forty cases in which the mother and progeny were saved in fourteen instances, the mother in fourteen instances, and the progeny only in six. Probably a large proportion of unsuccessful cases are not published. Bugniet admits that he had nothing but misfortune with the operation. Donnarieix, on the contrary, asserts that he had only one death in sixty cases on which he had performed the operation. This operation should not be carried out until other means of dilating the os, as described for spasm of the cervix, have been tried.

In favourable cases a muco-purulent discharge comes from the vulva for a period of eight or ten days after the operation, but the cow eats, ruminates, and in other ways appears quite normal.

The chief unfavourable sequels are peritonitis, resulting from infection of the peritoneum through the operation wound, metritis, or metro-vaginitis. These two diseases frequently cause the death of the animal. Occasionally there is excessive hæmorrhage, especially when the tissues are extremely vascular, as in carcinoma and sarcoma. To avoid the first two results, after the fœtus is removed the membranes should be taken away as soon as possible, and antiseptic pessaries inserted in the uterus or even B.I.P.P. applied to the incision wounds in the cervix uteri and the neighbourhood.

LAPARO-HYSTEROTOMY OR CÆSARIAN SECTION (GASTRO-HYSTEROTOMY).

Laparo-hysterotomy is an operation which has for its object the removal of the fœtus or fœtuses from the uterus of the parent by making an opening through the abdominal wall, and thereby extracting them.

Bourgelat and Brugnone first recommended the operation *in animals* which could not bring forth, in order to save the progeny. In 1813 Morange and in 1816 Goheir attempted the operation on the living animal, though unsuccessfully. Morange operated on a cow, and it was to all appearance in a fair way to recovery, when it succumbed to an attack of indigestion caused by improper feeding. Since that time laparo-hysterotomy has been practised comparatively often, both in this country and on the Continent. It has been practised both on the large and small domesticated animals, but with most success on the latter. In forty-eight cases of this operation, Franck finds that twenty-five, or 52 per cent., had a fatal termination. Saint-Cyr, from a smaller number, makes the mortality 71 per cent.

De Bruin records sixteen recoveries in twenty-three hysterotomies in the sow, Kasselman nineteen in twenty-five.

With regard to saving the young, the operation is not very favourable. In only four of Franck's cases were the parents, and one or more of the young creatures, saved. Three of these cases were bitches, and the other was a sow.

With the cow, the calf is often saved, while the parent dies. Of seven instances, the calves were extracted alive in six.

With the mare, the operation must be resorted to early in order to save the foal, as, for the reasons already given, it perishes quickly.

It is only on a knowledge of the length of time the fœtus may live during parturition, or after the death of the parent, that the operation can be undertaken with any prospect of success, so far as obtaining it alive is concerned; and this is an important consideration with regard to the bovine species. Kehrers, in his observations on the bitch, found that three minutes after death the fœtus began to show symptoms of

asphyxia, and in thirty-six minutes it was dead. In pregnant cows and sheep which were slaughtered, the fœtus moved about in a very lively manner for eight to ten minutes, but death ensued soon after.

Sauer observed an unusual instance of fœtal vitality in a bitch which could not be delivered, and was poisoned by cyanide of potassium. Eight minutes after death the fœtuses were observed to move in the abdomen, and this and the uterus being opened, they were extracted alive.

After fifteen minutes, Franck has found in slaughtered sheep that the fœtus was usually asphyxiated, and he concludes that during the first eight minutes after the death of the parent the fœtus can be extracted alive; even towards fifteen minutes there is a chance of preserving it, but by that time it is usually dead. When extracted late, and in the first stage of asphyxia, though it may rally for a short time, yet it usually succumbs to inflammation of the lungs, through the amniotic fluid having penetrated into the air-passages during the convulsive gasps the young creature makes.

There can be no doubt that much of the great mortality which follows the operation is due to the circumstances under which it is undertaken. It is, as a rule, never resorted to until every other means of delivering the animal has failed, and the creature, worn out by suffering, is already almost dead. In addition to this, the fœtus itself—subjected to long-continued and severe manipulation—is either dying or dead; indeed, it may have perished days before, and, becoming putrid, has already infected the parent.

Death is usually due, when not immediate, to putrid infection—to peritonitis or metro-peritonitis. This is more particularly the case with the bitch, in which, when the operation is performed early and the young are extracted alive, recovery generally takes place; though Franck remarks that wherever the green colouring matter of the placenta imparts a similar tint to the textures it comes in contact with, very often septic inflammation begins there. The same authority points out that there is no great reason otherwise why death should be a frequent result of the operation, when we consider the hundreds of similar operations performed in the study of embryology, by Bischoff and others, on bitches,

guinea-pigs, and rabbits, the majority of which did not have a fatal termination. He also alludes to the success of Nature's Cæsarian section, when we have mummification and maceration of the fœtus, consequent on occlusion of the os uteri, and the remains of the creature find their way out by another channel without much disturbance to the mother.

Certainly, the brilliant results obtained from antiseptic and aseptic surgery in other directions give reason to expect more successes from this operation—at least in the case of the smaller animals.

The most dangerous cases for operation are those in which the fœtus is dead and more or less decomposed.

Indications.

The operation should only be resorted to in those cases in which delivery by the natural passages—the fœtus being alive—is altogether impossible, or so difficult and dangerous that the mother incurs nearly as much risk as from laparo-hysterotomy itself, while the young creature must be sacrificed; or when the owner prefers having the latter alive, instead of incurring the risk of losing both, the progeny being the most valuable. The operation is therefore likely to be demanded in those deformities of the pelvis produced by fractures, exostoses, etc., which considerably diminish its canal, intrapelvic tumours, hernia of the uterus, extra-uterine fœtation, and certain cases of uterine torsion irreducible by the methods we have described. Atresia of the os in the larger animals should be more advantageously overcome by vaginal hysterotomy, unless the owner is desirous of saving the fœtus and sacrificing the mother.

The operation is also indicated when an animal, near the termination of pregnancy, is so seriously ill or injured that it cannot live until birth takes place. It may then be most judicious, if the progeny is valuable, to kill the parent and extract the fœtus at once. If the parent has just died, or is dying, the operation may also be practised.

In considering the adoption of the operation, the species of animal will, of course, weigh a good deal. Those which can be utilized as food there need be no hesitation in operating

upon and sacrificing immediately afterwards, the value of the carcase and the living calf or lamb diminishing very considerably the loss which would otherwise be sustained. With the mare, as we have said, the foal may be much more valuable than the parent.

With the bitch and sow there is much more prospect of a favourable result from the operation; and as difficult parturition in them is often so serious, it is advisable to operate in good time. Indeed, in all cases, when the operation is once decided upon, no delay should occur in practising it, if it is desired to preserve the progeny and give the parent a chance.

We have seen that the foal soon perishes when it cannot be born, and though the fœtus of other animals retains its vitality longer, yet there is also a limit here. Besides, it must be remembered that the strength of the parent is an important factor in the case, and the longer the delay, the less chance is there of a successful result. It is, therefore, most important that the obstetrist lose no time in making his diagnosis, and coming to a conclusion as to the course he must pursue. Embryotomy will, of course, present itself to his mind before laparo-hysterotomy, which is, after all, only to be an ultimate means of saving either mother or progeny, or both, in exceptional cases. It need scarcely be pointed out that in irreducible uterine hernia there need be no delay in deciding, and that this condition gives good hope of success, especially in the smaller animals.

Operation.

When the parent is dying or is doomed to be killed because it is worthless, or suffers from an incurable disease or accident, and the young animal is to be rescued, as in the mare or cow, the parent must first be killed by pithing, and then the abdomen opened rapidly—firstly, by a longitudinal incision through the abdominal floor from the xiphoid cartilage to the pubis; and, secondly, by a cross-incision through the side-walls of the abdomen. The uterus is then opened and the fœtus extracted.

When it is desired to preserve the parent as well as the offspring, then the usual antiseptic or aseptic surgical precautions must be taken.

All the instruments must be sterilized. These instruments should include a scalpel, probe-pointed bistoury, director, scissors, artery and dressing forceps, retractors in the larger animals, suture material, sponges or cotton-wool. The flank operation is to be preferred with the larger animals and the sow, as no sutures can resist the weight of the intestines when the incision is at the inferior part of the abdomen.

The cow, sheep, and goat must be operated on the right side, the mare on the left side, the sow on either side. The animal must be cast on the opposite side to that to be operated on, and anæsthetized. Chloroform may be used for the mare, cow, or sheep; with the sow a local anæsthetic is preferable, such as cocaine, for the incision in the abdominal wall. The upper hind-limb must be drawn backwards. The site of operation must be shaved, washed, and antisepticized; tincture of iodine is a convenient antiseptic to apply to this area. An incision is then commenced from a point equidistant from the external angle of the ilium and the last rib, and carried downwards and forwards in the direction of the fibres of the internal abdominal oblique. This incision is carried through the skin to the latter muscle. Its length varies according to the animal, in the mare or cow being from 12 to 14 inches. The layers of muscles are carefully cut through until the peritoneum is reached, and it is punctured, taking care not to wound the underlying viscera. The two first fingers of the left hand are passed through this opening, the back of the hand downwards; the blade of the probe-pointed bistoury is placed between these fingers, and carried along through the peritoneum until the opening is of the same length as that in the skin. An intelligent assistant should be at hand to prevent the escape of the intestines through this large aperture.

The arm of the operator is now pushed into the abdominal cavity in search of the uterus, which, when found, is brought opposite the incision, should it not be there at first. Two assistants compress the sides of the wound, so as to maintain them closely against the uterus; this the operator cuts through slowly, layer after layer, using all diligence so as to escape wounding the fœtal membranes.

Two fingers are insinuated between the walls of the organ

and these membranes, and the bistoury is again employed to dilate the opening, as in the peritoneal incision, so as to give it nearly the same direction and extent of that in the abdominal wall. Should the membranes be still intact, they are to be torn, and the "waters" allowed to flow—but only *outside* the abdomen, if possible. The operator now, plunging his arm at once in the cavity of the uterus, seizes the first part of the fœtus that comes to hand—fore-legs, head, or hind-quarters, if possible—and removes it quickly; the umbilical cord is torn or tied and cut through, and the young creature given to those who will dry and rub it, wrap it in a warm blanket, and otherwise attend to it.

The obstetrist immediately, if the parent is to be preserved, removes the fœtal membranes—an easy task comparatively in the mare, much more tedious and difficult in the cow, as all the adhering cotyledons must be separated one by one. Then, by means of a sponge, all the fluid remaining in the organ is to be cleared out, as well as any that may have escaped into the abdomen. It might be well to damp the interior of the uterus with a very weak solution of carbolic acid. Then the wound is to be closed by Lembert's sutures.

In the abdominal wall a row of buried sutures must be inserted in the abdominal muscles, and a quilled suture applied to the outer wound. Over this, long, narrow strips of canvas may be applied with pitch or some adhesive agent to support the sutures; and, last of all, a wide body bandage must be placed around the abdomen and loins of the patient. The latter is then allowed to rise.

In the bitch and cat, the operation may be performed either in the flank or in the linea alba. The latter site is very convenient, and allows of easy manipulation of both cornua of the uterus. In all cases, whether in large or small animals, if a fœtus is presented before the operation, it should be pushed forwards as far as possible into the uterus and an antiseptic injected.

For the operation through the linea alba, the bitch should be fixed on its back on the operating-table, and the site must be shaved, cleaned with ether, and dressed with tincture of iodine. A sheet of sterilized calico should be applied round the abdomen and an elliptical opening made in the calico over

the operation site, through which the abdominal wall is incised. The bitch may first be narcotized with morphia and anæsthetized with chloroform or A.C.E. mixture. The incision is made in the middle line from behind the umbilicus to near the pubis through the skin down to the peritoneum, the latter punctured with the knife at one end of the wound, the grooved director inserted, and the incision extended as required by the knife, guarded by the director. In some cases it may be possible by inserting the fingers into the abdomen through the incision in the abdominal wall and by manipulation through the uterine wall to press the fœtus out through the vagina. But where that is not practicable—*e.g.*, when the os is not dilated or passage through the vagina is out of the question —one horn of the uterus is now drawn through the wound in the abdominal floor, and a careful longitudinal incision made in it opposite its ligamentous attachment close to the body, sufficient to admit of the passage of the puppies (a similar incision is to be made in sows). The nearest puppy enclosed in its fœtal membranes is then manipulated through the wound and extracted. By manipulation, the other puppies in their membranes are pushed towards this incision in the uterine wall and removed. Where there are more than three or four fœtuses it will be necessary to incise each horn separately. If the puppies are alive, an assistant should be at hand to attend to them. The uterus is now mopped out with sterilized normal saline solution or a little antiseptic lotion, such as chinosol (1 to 1,000), the opening in the uterine wall closed with Lembert's sutures of catgut or silk, and the edges of the wound in the abdominal wall brought together by two rows of interrupted sutures, one in the abdominal muscles, the other in the skin. A little collodion and boric acid is now employed to seal the wound. If the abdomen is very heavy, a bandage may be employed to support it. The animal is then allowed to rise. The after treatment is as for other abdominal operations—clean surroundings, rest and light, easily digested food, which must not distend the abdomen, and therefore must be sparing in amount for a few days.

The bad results to be apprehended from the operation are septic metritis or peritonitis, or both, abscess at the seat of the incision, or adhesion of the abdominal organs to this part.

HYSTERECTOMY.

Hysterectomy consists in removing the uterus enclosing the fœtuses through a wound in the abdominal wall. It is commonly performed in the smaller animals—the sow, bitch, and cat. It is especially to be recommended when the fœtuses are dead and decomposing. It is much less dangerous to the mother than hysterotomy, but the disadvantage is that she cannot be any longer used for breeding purposes.

The procedure is the same as for hysterotomy, as far as the opening of the abdominal wall.

One horn is first brought through the outer wound, and the ovarian vessels ligatured. It is just as well to remove the ovaries with the horns. Then the horn is separated from the uterine broad ligament, care being taken not to injure any bloodvessels ; the other horn is treated in the same way. Then two ligatures are applied to the body of the uterus, including the uterine vessels, after it has been ascertained that the fœtuses and their membranes lie in front of this point. The body is then cut through between the ligatures and the uterus taken away. The stump of the body, still attached to the vagina, is carefully disinfected and returned to the abdomen. The further procedure is as for hysterotomy.

ARTIFICIAL PREMATURE BIRTH.

The production of abortion has already been described. It is estimated that the fœtus would be viable, and yet notably less in size and weight than when born at full term, if removed from the mare twenty to forty days before that period ; from the cow, fifteen to thirty days; and from the bitch, ten to fifteen days.

Artificial premature birth is produced in the same way as artificial abortion.

SUPPLEMENTARY OBSERVATIONS REGARDING MOTHER AND PROGENY.

The condition of the mother after obstetrical manipulations and operations generally demands attention—all the more if these have been severe and protracted. In trifling cases, it is true, no care beyond that usually given after normal parturition is required, for as soon as delivery is completed she will seek her offspring—if it be alive—and manifest her interest in it, though she may have suffered considerably before it was born. But in the great majority of difficult cases, such as have been described in the preceding chapters, the animal is much prostrated from prolonged suffering and straining—so much so, indeed, as to lie extended in a comatose condition, or apparently dead, from nervous exhaustion. Though the mare can endure very much suffering during parturition, yet this state of collapse is not infrequently observed. So stout-hearted is this animal that when she has rallied from the effects of parturition and evinced maternal solicitude for the foal, she begins to eat and drink; when she does not do so, it may be regarded as a very grave sign.

To render the mother comfortable and restore her strength should be the first consideration. The body ought to be rubbed and dried, and covered with warm clothing; stimulants must be given, as well as warm gruel and tepid water to drink. If resting, she ought not to be disturbed; though, in the case of the larger animals, some authorities assert that if recumbent they ought to be got up if possible, as the internal generative organs then assume their natural position more readily. But unless there is apprehension of inversion of the uterus, it is generally the best course to allow repose.

For cows much exhausted in calving it has been recommended to give a subcutaneous injection of veratrine (4 to 5 grammes in alcoholic solution, 1 to 25) or strychnine, which soon rallies them. When, after delivery has been effected, animals remain restless, and apparently suffering pain, they should receive soothing medicine, such as chloral hydrate, either in gruel or enema.

If the young animal is alive and able to suck, it should be put to the teat; if it is dead or unable to suck, then the mother must have the milk taken from the mammary gland.

Any contusions or injuries to the maternal generative organs should be attended to next; the treatment to be adopted will depend on the nature and seat of the lesions, but it ought to be antiseptic whenever possible. This must also be the rule when the fœtus has been extracted in a decomposed state; the uterine cavity must be well syringed out with warm boiled water, and subsequently irrigated with some antiseptic fluid, such as potassium permanganate (1 to 1,000). Permanganate of potash solution, if used, should be injected until it is returned unchanged. As long as it is passed out as a brownish liquid, the injection should be continued.

With regard to the young animal when it is extracted alive, the damage it has received should be ascertained; this can be done when the cords are removed. The slighter injuries are usually simple wounds, and soon heal; but fractures of bones are more serious, and generally necessitate slaughter of the animal. If looking healthy, yet it cannot get up or stand when lifted up, this is in all probability owing to strain of the limbs, and passes off in the course of a few days.

When apparently dead, besides the measures already mentioned for this condition, veratrine has also been given with great advantage subcutaneously, 1 or 2 centigrammes being the dose. In other cases in which the calf could not respire—though the heart was contracting rapidly and violently—it has been placed near the open door, with the head pendent, in order to send blood to the brain, while the limbs were vigorously rubbed and the chest compressed and relaxed alternately; these measures not succeeding, a small quantity of brandy carefully administered has produced the desired effect, and respiration was soon established.

Sometimes it happens that the calf has been retained in the genital canal for some hours, with its head partially out of the vulva, and owing to the pressure on the neck there is much swelling of the head, especially of the tongue, which is turgid and projects from the mouth. When extracted, the creature can scarcely breathe because of the tumefied tongue, and asphyxia is imminent. Scarifications of the organ, with turpentine in oil rubbed on the limbs, soon bring relief.

CHAPTER XI

ACCIDENTS AFTER PARTURITION

The *accidents* occurring subsequent to parturition are rather diverse, and not infrequently complicate the difficulties already alluded to as hindering natural birth. They may occur either during parturition, immediately after delivery, or within a few days subsequent to that event.

In addition to the accidents, there are *diseases* which appear during the puerperal period, though the distinction between them and the former is not always easy to establish.

Some of the complications just alluded to may succeed a perfectly normal delivery, or an accidental abortion, as well as a difficult birth.

The accidents consecutive to or accompanying parturition may be enumerated as follows: (1) *Retention of the fœtal envelopes in the uterus, and its consequences;* (2) *Post-partum hæmorrhage from the genital organs;* (3) *Displacement or hernia of one or more of the internal genital organs through the vulva;* (4) *Traumatic lesions of the genital or neighbouring organs.*

Some of these accidents are either very serious in themselves or in their consequences, and require the greatest skill to remedy; or they are comparatively trifling, and easily repaired.

RETENTION OF THE FŒTAL ENVELOPES.

The retention of the fœtal envelopes, placenta, "secundines," or "after-birth," beyond a certain time after the expulsion of the fœtus from the uterus must be looked upon as an accidental or pathological condition which requires attention. It has been already shown that the placenta is

usually shed or expelled soon after the young creature is born, and particularly with such animals as the mare, sow, and bitch, the placenta of which is diffuse or zonular; indeed, with multiparous animals—as the two latter—the placenta of each fœtus is extruded, soon after its birth, by the succeeding fœtus; so that if retention occurs at all, it is only the last or the two last placentæ which remain in the cornua of the uterus.

With ruminant animals, however, retention is far from rare, though even in them there is a difference in this respect, according to species, the accident being much more frequent in the cow than in the sheep or goat. This frequency in ruminant animals is doubtless due to the peculiar formation of their placentæ, the cotyledonal arrangement being evidently opposed to ready separation.

But if the cow is the animal of all others in which this accident occurs, it is also the one which appears to be the least inconvenienced by it; for it is not uncommon to see cows which four, six, eight, and even ten or twelve days after parturition, have not got rid of the placenta, and yet are lively, the appetite is unimpaired, and they continue to ruminate and give milk as if there were nothing amiss; though in some instances the animal may stamp with its hind-feet, raise the tail, and act as if about to defecate or micturate, while a small quantity of fœtid sanious fluid escapes from the vulva.

Symptoms and Terminations.

The symptoms are generally so marked that the state of affairs is readily discovered. Nearly always there is a more or less considerable mass of the fœtal envelopes—sometimes only the umbilical cord—hanging from the vulvar orifice, the labia of which are often swollen and injected. Occasionally the mass is so large as to reach below the hocks, with little bags of liquor amnii at the lower end; it has, if recently expelled, a fresh tint, not unlike that of the intestines; but if exposed for some time, and especially in summer, it is greyish coloured, somewhat adhesive, and generally soiled by fæces or litter.

In other cases nothing is noticeable, except when the animal is lying on its abdomen; then the pressure on the uterus pushes the cervix into the vagina, and if any portion of the membranes is through the os, of course it is visible. In others, again, nothing whatever is to be seen whether the creature is lying or standing, the whole mass being retained in the uterus. After the third day of delivery the os is usually closed, and unless a portion of the membranes chanced to be in the vagina before this period, the entire placenta is imprisoned in the uterus, and a manual exploration will not always discover it. Sometimes only a fragment of the membranes is so retained.

It has been mentioned that in many cases the animal does not evince any uneasiness at first; sometimes when the portion of placenta hanging outside the vulva is large and heavy, and the creature is standing, the meatus urinarius is pressed upon, and micturition is rendered difficult. There may also be symptoms of abdominal pain—whisking the tail, stamping with the feet, and making efforts as if to defecate or micturate, with slight and brief uterine contractions, which may eventually lead to the expulsion of the placenta.

It often happens that when the os is not completely closed, owing to a portion of the membranes lying in it, spontaneous expulsion takes place after a variable period.

When once spontaneous expulsion has been effected, there is little to be apprehended. It is not so if retention be accompanied by decomposition of the membranes; this occurs when air has access to them, and all the more rapidly when the temperature is high.

The odour is most repulsive, and a sanious brown-tinted discharge, composed of débris of the membranes and secretions from the irritated mucous lining of the genital canal, flow from the vulva, soiling it, the tail, thighs, and hocks, and often excoriating them. This discharge is most abundant when the animal extends itself to micturate, and it is then horribly fœtid. The hand, on being passed into the vagina, is covered with the fluid, and it may encounter shreds of the placenta.

In such cases the health of the animal often suffers; there is dulness, prostration, diminution in the secretion of milk.

decreased appetite, respiration perhaps quickened, temperature increased, and other indications of illness.

The complications from placental retention are somewhat numerous. Contact with the decomposing membranes may so irritate the interior of the uterus as to occasion metritis, or even metro-peritonitis—a condition which is always serious, and often fatal. There is also risk of septicæmia; and even under the most favourable circumstances there sometimes remains a local irritation—a chronic vaginitis or metritis that leads to leucorrhœa.

Some authorities have observed trismus, tetanus, metastatic arthritis, and chest affections, as sequelæ of placental retention.

There is no danger when the retention has only lasted for two or three days, particularly if a large portion of the membranes protrudes beyond the vulva, and it has a fresh tint. Attention is necessary, however, when the placenta begins to putrefy, and a fœtid discharge commences from the vulva; though even so late as fifteen days after parturition the membranes may be expelled spontaneously, without any injury occurring from the prolonged retention. But the case is serious when the animal begins to show symptoms of general illness, and particularly if no portion of the placenta can be seen or the os be occluded. Plastic adhesion of the placenta to the uterus is also a grave complication, though happily rare.

In these instances the animal gradually becomes listless, weak, and emaciated, loses its appetite and ceases to yield milk, until at length it falls into a state of marasmus, and perishes from septicæmia. Or, in more rapid cases, with these general symptoms the lining membrane of the vagina is of a deep red colour and intensely hot, a fœtid sanguineo-purulent discharge escapes from the vulva; there are tremblings over the whole body, hurried respiration, intense fever, and all the other signs of metritis.

Though retention is not, in the majority of cases in the cow, a very serious affair, yet it should be attended to even in this animal. With other creatures it is much more to be dreaded, as they incur greater risks from prolonged retention.

Causes.

Retention occurs most frequently in cases of abortion, or when birth takes place some days before the proper time. The accident is stated to be more frequent with old cows, and especially when these are employed in draught, as in France and other countries.

In some cases it is due to abnormal adhesion between the maternal and fœtal placentæ. Pomayer maintains that in large proportion retained fœtal membranes are due to inflammation and swelling of the maternal placenta. This inflammation may result from injuries through the abdominal wall during gestation, or occur in contagious abortion or other infection of the uterus. This does not appear to be a very satisfactory explanation, because if the placenta is much interfered with abortion will soon take place, before the change has been sufficient to cause swelling of the maternal placenta and a consequent narrowing of the crypts sufficient to retain the fœtal membranes. Protracted and laborious birth favours retention. Probably the large majority of the cases are due to uterine inertia, absence or feebleness of the uterine contractions. This want of contraction is frequently noted on examination of the uterus in retention of the fœtal membranes.

When the cervix uteri contracts rapidly after delivery, and the os is consequently firmly closed, the placenta, though non-adherent, will be retained.

Rueff mentions that the accident is especially frequent in certain years when the herbage and forage is not good, and particularly when the latter is mouldy.

Treatment of the Cow.

The treatment of placental retention appears always to have been a subject on which diverse views and opinions have been held, many obstetrists maintaining that—with the cow more particularly—this retention is never dangerous in itself, and that, unless there arise complications, the removal of the fœtal membranes should in every case be left to the efforts of Nature; while others assert that there is great risk in this retention, and that when it has exceeded two or three days

after the birth of the fœtus there is need for active intervention. The experience of the majority of obstetrists will negative both of these opinions; for it is a matter of almost daily observation that in many instances the placenta remains without inconvenience in the uterus for several days—six or eight—before it is spontaneously expelled; while in other cases retention for the same period is marked by more or less serious symptoms. This difference undoubtedly depends upon circumstances, the precise nature of which cannot always be fully ascertained. Nor can positive rules be laid down as to when it is time to interfere, or when abstention is the prudent course; this can only be learned by individual experience and the tact of the practitioner.

It may be remarked, however, that when parturition has been normal, when the cow does not appear to suffer pain or inconvenience, when the "straining" is infrequent and slight, the appetite good and lactation established, and particularly when, during a low or moderate temperature, a portion of the membranes protrudes beyond the vulva, then there is no great reason for interference until a week, or even more, has elapsed.

But if, on the contrary, the external temperature is high, if the labour has been difficult, the genital organs irritated or abraded, and if fever, restlessness, and suffering, are noted, with strong and frequent straining, especially if there are foul-smelling discharges from the vagina, then intervention is called for, no matter whether the time which has elapsed since parturition is long or short.

When the envelopes form a somewhat large mass hanging from the vulva, it may be anticipated that early and spontaneous removal will take place; though it sometimes happens, as has been pointed out, that the weight of the pendulous portion causes inconvenience in micturition, while it fatigues and pains the animal by dragging on the uterus, and induces expulsive but futile efforts. Schaack has shown that in nearly all these cases it will be found that a loop of the membranes has become twisted around the pedicle of some large uterine cotyledon; and as this is the obstacle to separation, it is necessary to release the loop as soon as possible, in order to prevent accidents.

It has also been remarked that, even when birth has been easy and favourable, primiparæ are often irritable and impatient, the presence of the secundines in the vagina and vulva increasing the restlessness, and occasioning frequent and energetic uterine contractions, and the os uteri closes very rapidly. In such cases it will generally be found judicious to remove the membranes as soon as possible—on the same day, or the day succeeding delivery, if necessary.

If after the birth of the fœtus nothing is seen at the vulva except a thin cord, formed solely by the umbilical vessels, it is almost certain that there is strong adhesion between the uterus and placenta, and that the separation of the latter will be protracted—in all likelihood it will require to be removed artificially. But even in such a case there is no occasion for immediate interference; on the contrary, it is more judicious to wait, and allow time for the placenta to soften and the adhesions to diminish, though the opportunity for complete detachment must not be overlooked.

When nothing whatever is discernible externally, there is reason to surmise that the placenta is completely retained. But even in this case there is no need to resort at once to its removal, though it may be necessary, in order to prevent imprisonment for some time, through the closure of the os uteri, to introduce the hand into the uterus, and, if the placenta is already partially detached, to extract it. If it remains firmly adherent, however, it is better to gather as much as can be seized into a single mass, carry it through the os into the vagina, and, tying it there by a long piece of cord, to leave the latter hanging outside the vulva. This prevents the os from closing, while the cord will assist in effecting artificial removal at a later period, should such be required.

Certain medicaments, more or less of the nature of emmenagogues—such as ergot or ergotin, rue, savin, laurel, stramonium, carbonate of potass, etc.—have been for a long time credited with the power of hastening the expulsion of the placenta, and their administration has been recommended before resorting to manual force. Some of the recipes for these potions are very antiquated, and others are quite modern.

Purgatives and stimulants are also used with the object of inducing uterine contractions.

Probably the chief advantage of these medications lies in inducing the owner of the animal to exercise patience until spontaneous expulsion is effected, the least active measures being the best. Uterine contractions can best be stimulated by intramuscular injections of pituitrin in doses of 5 to 10 c.c. for the cow. This is also useful when the uterus remains flaccid after the fœtal membranes have been discharged in inducing involution.

For a very long time an empirical mode of removing the placenta, when a part of it protruded beyond the vulva, was to exercise slight and continuous traction on it by attaching a weight to the pendulous portion; in France the farmers attach a sabot filled with gravel. Favre of Geneva, who notices this rude method, admits that a weight not exceeding 2 pounds may be suspended from the membranes, which are collected into a mass and tied with a piece of hemp. This method is, however, objectionable from several points of view.

Manual traction is often employed when a portion of the membranes is visible. This is seized either by the hands or by means of a towel or wisp of hay or straw, and gently pulled at—particularly when the animal strains—twisting it at the same time, until the whole mass is removed from the uterine cavity.

This traction is not likely to be productive of much injury to the mare, sow, or bitch, as the adhesion of the placenta is not great, and is usually limited to a few points; it is therefore, as a rule, generally and quickly successful in these animals.

With the cow, however, it is not so, owing to the numerous and often strong attachments of the placenta, and its fragile texture, which renders it easily torn if too much force be employed; if it does not give way, and the traction is immoderate, then there is risk of irritating the uterus, tearing away the cotyledons, or producing partial or complete inversion of the cornua, or even of the entire organ. Should the placenta give way, this may lead to greater difficulty in removing what is left of it in the uterus.

For these reasons some practitioners discountenance this mode of abstracting the placenta; but there can be no doubt that if the traction is moderate and judicious, the membranes not very adherent to the interior of the uterus, and a good part of them beyond the os, the operation is quite justifiable and will be successful. When, however, the resistance is marked or the membranes begin to tear, it is better to desist.

Deneubourg recommends the following method as better than employing the hands: The protruding umbilical cord is seized between two pieces of wood, the length and size of an ordinary walking-stick, and rolled round them until they are close to the vulva; there, by a slight and gentle circular movement, the portion engaged in the vagina produces a kind of titillation which induces the animal to stretch as in micturition—an act it nearly always accomplishes—and during this period the membranes are rolled round the pieces of wood as they are detached, which usually occurs in about six days, when the whole is removed. When resistance is experienced, and anything is found to tear or rend, it is evident that adhesions still exist, and the rolling must cease; but then, by a kind of jerking movement from side to side, there is communicated to the uterus a series of shakes more or less energetic, according to the state of the organ. Deneubourg says that there need be no hesitation in employing a certain amount of force in practising these movements: "We may act strongly, but gently." Great success is said to have attended this method.

But, after all, there can be no doubt that the more scientific and surgical plan—direct extraction by enucleation of the cotyledons—is preferable. This method consists in passing the hand into the uterus, and detaching or enucleating the cotyledons, one by one, so as to destroy the adhesions between the maternal organ and the fœtal envelopes, when the latter can be taken away.

When this extraction should take place will depend upon circumstances. It will generally be found that it will not be successful before the third day, as the cotyledons are too closely and firmly united to allow their disunion without injurious force, which may bring about inversion of the uterus, or laceration of the maternal cotyledons, and con-

sequent hæmorrhage. About the third day is generally a favourable period, as the cervix is still sufficiently relaxed to pass the hand through the os into the uterus; while disintegration between the fœtal and maternal cotyledons has advanced sufficiently to permit the hand to complete the disunion without need for violence. It sometimes happens, however, that extraction can be effected so late as the fifth or eighth day after delivery; but then the membranes are extremely friable, and will scarcely withstand any degree of traction. Besides, the operator himself incurs great risk of infection, either local or general, from the absorption of the putrid matters in the uterus by the skin of the hand and arm.

An assistant holds the tail of the animal to one side, and the hand and arm, well oiled, are passed into the vagina; if a portion of the membranes is in this canal, then the operation is not so difficult, as the os will probably be more or less relaxed, and this portion lying towards the palm of the hand —the back of which is upwards—serves as a guide; while the left hand pulls at it gently, as occasion requires. When, however, nothing of the envelopes is to be found outside the os, and that opening is firmly closed—as happens four or six days after birth—then it may be very difficult to reach the interior of the uterus. One finger must be at first introduced, then two, three, and so on, until the hand in the form of a cone, and by a semi-rotatory motion, can be passed through. This operation is often long, troublesome, and fatiguing, and requires to be carefully managed, so as not to bruise, irritate, or wound the organ.

When the hand reaches the interior of the uterus, it is pressed forward between the mucous membrane of the latter and the chorion—the palm towards the latter—separating them as it advances until it meets with the cotyledons. Some of these—the maternal—may be detached from the membranes, while others are still embedded in them, as it were, through their fœtal cotyledons. These last have to be enucleated; and to effect this, the cotyledon is gently pressed at its base between the thumb and index-finger, and, if necessary, the fingers are moved over each other as if removing a button from its buttonhole. Other practitioners make pressure on the summit of the cotyledon by the three first fingers,

and thus destroy the adhesion. In this manner the hand passes from one cotyledon to another, effecting disunion as rapidly, yet carefully, as possible. At times a cotyledon will be met with which adheres so very firmly that it cannot be detached in the way just mentioned. Then the nail of the thumb or other finger must be gently insinuated at the border, so as to gradually raise it, and pass the finger over its entire surface.

The tediousness of the operation will be inferred when it is known that the number of adherent cotyledons may sometimes amount to more than a hundred; and the fatigue is often so great that the right and left hand have to be employed alternately—a circumstance which has advantages otherwise.

When a certain number of cotyledons are detached, the portion of envelopes so released is carried into the vagina and beyond the vulva, where the other hand, or an assistant, seizes and pulls gently on it.

As the hand reaches the cornua the cotyledons increase in number, and it becomes difficult to reach them—particularly the cornu in which the hind-limbs of the calf were lodged—because of the insufficient length of the arm. Moderate traction, however, on the part just detached will bring the others nearer, and facilitate the task; but the traction must be judiciously managed, so as to avoid tearing the membranes or the adherent cotyledons, invagination of the cornu, or even inversion of the uterus. So likely are these accidents to happen, that some practitioners, instead of pulling at the membranes in this way in order to disunite the most distant cotyledons, are content to await their natural separation, merely tying near the vulva the portion of the membranes separated, and cutting away the parts beyond—the separation generally occurring in from two to five days. To facilitate traction, Gunther recommends that the abdomen of the animal should be well raised by a plank placed under it, and held by assistants.

It has sometimes been found, as already mentioned, that the greater part of the membranes has been expelled, when all at once expulsion ceased, notwithstanding the volume and weight of the pendulous mass, which caused so much disturbance to the animal that it has refused to eat, persisted in

lying, and when compelled to get up has kept stamping its hind-feet until it could lie down again. On introducing the hand into the uterus, it is discovered that this unusual interruption to the expulsion has been occasioned by one or two large maternal cotyledons becoming entangled in the loop of a fold of the membranes. Sometimes the drag on these cotyledons has been so great that they have been brought as far as, or even beyond, the os. Relief has been given by cutting the membranes off by scissors, close to the vulva, and then releasing the cotyledons. The greatest possible care must be taken not to injure the intact mucous membrane of the uterus.

When extraction of the membranes has been properly conducted, there is no hæmorrhage ; if bleeding ensues, then one or more of the maternal cotyledons have been injured, or perhaps torn off altogether—an accident not without danger sometimes, and all the more serious if a number of the cotyledons is involved. This injury may lead, in addition to hæmorrhage, to uterine irritation, metritis, or uterine phlebitis.

Still, such an untoward accident is not always the result of injury to the cotyledons, as instances are recorded in which great numbers, or even the whole of the maternal cotyledons, have been torn away by ignorant empirics, and yet the animals have survived ; fecundation and gestation may even take place after ablation of the cotyledons. Nevertheless, these cases must be looked upon as entirely exceptional, and should not be relied upon as evidence that these bodies can be injured with impunity.

In order to be assured that the whole of the fœtal envelopes has been removed from the uterus, it is well to make an examination of them. Knowing their formation and extent, there should be no difficulty in ascertaining whether they are all present. If the fœtal membranes cannot be removed without injury or trauma, it is advisable to insert one or two antiseptic pessaries into the uterus and the attempt repeated after twenty-four or forty-eight hours.

After the removal of the membranes, there remains in the uterus a quantity of thick, grumous, diversely coloured, and more or less unpleasant-smelling liquid, which is derived from

the fœtal fluids, the blood that has escaped from the umbilical cord, and the partly decomposed envelopes. As its retention is likely to do harm, particularly if there is any wound or abrasion of the mucous membrane, as much as possible of it should be removed by the half-closed hand. Douching the uterus with boiled water, normal saline, or mild antiseptic solutions such as ½ per cent. lysol or 1 to 2,000 potassium permanganate is often practised in order to remove the debris and infected material, but it is often impossible to syphon out the solution, and any solution left may irritate the uterus, increase its distension if uterine inertia is present, and even lead to rupture of the organ. It is always better in these cases to insert uterine pessaries or antiseptics such as B.I.P.P. and stimulate involution by administering pituitrin. Douches have been claimed to spread infection through the uterus. In any event, the involution of the uterus is the most favourable means by which the debris and fluids and infections of the uterus will be expelled.

When extraction of the envelopes has been effected in good time and with the necessary precautions, the cow bears the operation very well and does not appear to be much inconvenienced, so that little after-treatment is needed. Gentle walking, if the weather is fine, in order to calm its restlessness and to allay the straining, if it is still present; keeping it in a well-lighted and properly ventilated stable, with a blanket over the body if the temperature is low; a few enemas, if constipation threatens; and a light laxative diet, with bran, oatmeal, or linseed gruel, are usually all that is necessary.

When the envelopes have putrefied in the uterus, through delay in removing them, and an abundant and fœtid discharge flows from the vulva, the animal itself being unwell and feverish, then the case is serious, and requires instant attention. The uterus must be cleared without delay from its putrescent contents, and in order to accomplish this the hand must be passed into the organ, and everything removed which it can possibly seize. Before doing so, however, the hand and arm should be well and frequently smeared with carbolized lard, butter, or oil, to prevent septic infection of the operator; if there are wounds or abrasions upon them, the greatest care should be taken in this respect—indeed, it is questionable

whether they should be introduced at all if the skin is not intact.

When everything has been taken away which the hand can remove, then the interior of the organ should be thoroughly cleansed by the continuous injection of tepid boiled water or sterile normal saline solution from a large syringe and tube, until the fluid comes away perfectly clear.

Very weak solutions of the before-mentioned antiputrescents should then be injected, but they must not be allowed to remain. If any fluid is retained in the uterus, as much of it as possible should be syphoned out. Instead of injections of antiseptic fluids, antiseptic uterine pessaries or other antiseptic preparations may be introduced. Agents such as pituitrin or quinine which will tend to stimulate contraction of the uterus may with advantage also be administered. Should the discharge continue, this treatment may be repeated at intervals of two or three days until it ceases, and tonics, stimulants, and antiputrescents (as sodium sulphite or small doses of carbolic acid), be administered internally. Good food and cleanliness are also essentials in treatment.

The hands and arms of the operator should be thoroughly washed as soon as possible after the uterus has been emptied; for this purpose nothing is better than carbolized soap. On the slightest sensation of uneasiness in the arm, advice should be taken with regard to it, as an attack of *ecthyma parturitionis* is often a serious affair, and has necessitated the amputation of fingers, and even the greater portion of the arm.

So dangerous and unpleasant, indeed, is the removal of a putrid placenta (the odour being often most sickening), that disinfection by intra-uterine injections of solution of cresyl, carbolic acid (½ per cent.), boric acid, corrosive sublimate (1 to 2,000), etc., is regularly practised by some veterinary surgeons. The interior of the uterus is first washed out with warm water by means of a syringe, or a long india-rubber tube to which a funnel is attached, and into which the water is poured. The injection is continued until the water that comes away from the vagina is colourless and odourless; then the disinfectant can be thrown into the uterus, and the arm introduced to remove the placenta. But the latter

measure is rarely necessary, as the injections generally suffice to detach it.

Retention of the Fœtal Membranes in the Mare is much less frequent, but much more serious, than in the cow. The causes and symptoms are similar to those in the cow. Frequently only a portion of the fœtal membranes are retained, and hence in all cases it is necessary to examine the membranes which have been ejected, to ascertain whether they are complete. So liable is the mare to septic infection that manual extraction of the membranes is always indicated when they are not expelled immediately after birth. Serious sequelæ of this condition are metritis and laminitis.

As in other animals, all cleanliness and antiseptic precautions must be taken in removing the membranes. Sometimes the membranes lie detached inside the vulva or at the os uteri, and a little traction removes them. In other cases they must be located, and a portion brought outside the vulva, to be held secure by one hand, while the other is inserted into the uterus and gently and cautiously pushes the fingers or knuckles between the placenta and the uterus. The fingernails must be short, in order to avoid injuring the uterus. This process is carried out equally around the entire circumference of the uterus until the entire fœtal membranes are removed. Then the uterus is treated.

In the Smaller Animals retention is not very common. When it does occur, then it must be treated in the same way as in the larger animals. If manual removal cannot be carried out, then the uterus should be irrigated with warm antiseptic or normal saline solution to cleanse the organ. Frequently the administration of pituitrin suffices to effect removal of the fœtal membranes.

POST-PARTUM HÆMORRHAGE.

Hæmorrhage from the uterus, or "flooding," after abortion or the birth of the fœtus at the ordinary term—an accident so frequent and alarming in woman—would appear to be far from common in the domesticated animals. This difference between the female of the human species and that of animals

is evidently due to the dissimilarity in organization of the uterine mucous membrane in them at the insertions of the *placenta fœtalis*.

Nevertheless, whether owing to some anatomical or pathological peculiarity, to atony of the uterine walls, rupture of vessels during removal of the fœtal placenta, or even during its spontaneous expulsion, almost every practitioner of any experience has met with cases of metrorrhagia of a more or less alarming character. So serious, indeed, is this hæmorrhage that the mortality has been estimated as high as 73 per cent. of the cases reported.

In certain instances there can be no doubt that, as in woman, insufficient contraction of the uterus is a cause of post-partum hæmorrhage; and, according to Schroeder, this atony of the organ is especially observed after a rapid emptying of its cavity, whether artificially or naturally produced, also after a previous and very considerable distension. It therefore occurs after very rapid delivery, too early turning and extraction, in hydramnios, and at the birth of twins. The hæmorrhage is sometimes also due to general debility, and feeble development of the uterine muscles—either congenital or depending upon previous very difficult labours. Partial adhesions of the placenta to the uterine wall, which, however, are rarely caused by real connective-tissue bands, may also give rise to profuse hæmorrhage, as the separated places in the vicinity of the adhesions can only imperfectly contract.

Symptoms.

The symptoms of post-partum hæmorrhage are not well marked unless the bleeding is visible, though they are those of profuse hæmorrhage in general. There is the quick, weak, running-down pulse, which becomes imperceptible as death approaches, and the throbbing, irregular contractions of the heart; the decoloration of the mucous membranes, rapidly increasing prostration of the animal, with the unsteady, staggering gait on movement, and the difficulty of maintaining the standing position towards the end; the haggard facies; with chilliness of the surface, cold, clammy perspiration breaking out over the body; and, finally, the recumbent position, convulsions, and death.

Sometimes there are indications of abdominal pain, indicated by pawing and looking anxiously at the flanks; but these indications are only likely to be present when the hæmorrhage is due to traumatic influences. When the hæmorrhage *per vulvam* is discernible—coming away in a fluid condition or in masses of clots—then, of course, there can be no difficulty in diagnosing the accident; but when it is entirely internal, the manifestation of the symptoms above indicated should give rise at once to a suspicion of the state of affairs, and lead to a manual exploration of the uterus.

The essential indication in the treatment is to suppress the hæmorrhage as speedily as possible; the next, to sustain the vital powers of the animal.

If the fœtal membranes have not been expelled, they must be removed without delay, yet as gently as possible; for until their removal is effected the uterus will probably not contract. The contraction of the organ is very important, and when the membranes are present it often happens that the manipulation required to remove them brings about this result. If the membranes are not present, then the hand and arm must be pushed into the uterus and gently moved about, in order to excite contraction, if the organ is flaccid and uncontracted. At the same time its interior should be freed from the blood and clots it may contain; cold-water douches must be applied to the loins and vulva, as well as injections of the same into the uterus. If deemed necessary, a towel, or sheet steeped in cold water, or a large sponge impregnated with vinegar and water, perchloride of iron, suprarenin or adrenalin, or any other styptic, may be passed into the vagina, or even into the uterine cavity.

Pituitrin has proved of great value in this condition and is the agent now usually employed, but many drugs have been used from time to time as hæmostatics in post-partum hæmorrhage. Internally, tannic acid, salts of lead and morphia, perchloride of iron, tincture of ergot of rye, the hypodermic injection of ergotin, or any other agent likely to act as a hæmostatic, have been administered.

Hypodermic injections of morphia have been recommended,

and large doses of oil of turpentine – for the cow from 3 to 5 ounces, mixed with the contents of half a dozen eggs—have been successfully employed by Macgillivray.

To counteract the effects of the loss of blood, rectal or hypodermic injections of normal saline solution may be tried.

INVERSION OF THE UTERUS.

Inversion, procidence, prolapse of the uterus, or *vagino-uteral inversion*, signifies a displacement or kind of hernia of the organ, which is partially or completely turned inside out—the inverted fundus escaping through the os uteri (*partial inversion*), vagina, and vulva, and perhaps descending as low as the hocks (*complete inversion*), where it forms a more or less voluminous tumour.

When the inversion is very partial, nothing whatever is seen externally, and an exploration alone reveals the existence of the accident; if more developed, the uterus appears as a round tumour between the labia of the vulva when the animal is lying, and especially if the floor of the stall slopes backwards, which causes the gastro-intestinal mass to press upon the organ. Sometimes the procidence is so very slight that there is merely a bulging inwards of the fundus of the uterus or of one of the cornua.

In complete inversion there is frequently prolapsus of a portion of the vagina, which appears in two forms or degrees, according as there is inversion of the body of the uterus or inversion of the cornua as well; sometimes it is only one cornu, which is then deviated to the right or left of the vertical direction of the body of the organ, just as it happens to be one or other of these parts. If both cornua are completely inverted, they terminate inferiorly in the form of a cone; but if they are only incompletely so, then they remain cylindrical at their lower end, at the centre of the cylinder being a depression or cæcal cavity.

Inversion of the uterus is, of course, only possible when the os uteri is dilated; consequently it occurs immediately after birth.

Again, inversion is *simple* or *complicated*. It is *simple* when

the viscus is intact, uninjured, and not accompanied by the extrusion or displacement of any other organ. When it is wounded or torn, or when there is accompanying hernia or protrusion of other viscera, then it is *complicated.*

As we have said, ruminants are most liable to this accident; the cow coming first, then the sheep and goat; the mare is less frequently affected, and the sow and bitch perhaps not so often as the mare. Inversion of the uterus has been observed in the cat and rabbit.

With the bitch and sow, incomplete inversion of the uterus is far from uncommon, as is also simple inversion of the vagina, for which it might be mistaken. In uniparous animals the whole of the organ is usually inverted; while in multiparous creatures, generally little more than the portion which contained the fœtuses is involved.

The accident has been observed in animals kept in houses, as well as in those roaming about at liberty; and it has been known from time immemorial. The Roman veterinarian Vegetius alludes to it, and recommends the employment of an inflated pig's bladder as a good pessary.

Symptoms.

The symptoms of uterine inversion vary with its extent. With uniparous animals, inversion always commences at the fundus of the organ, most frequently towards the largest cornu where the greater portion of the fœtus was lodged. Under the influence of an irregular kind of spasmodic contraction, this part is drawn or pushed inwards, just as the foot of a stocking is inverted; and this action continuing, the fundus or cornu is more or less rapidly carried towards the os, through which it passes into the vagina (*incomplete inversion*), dragging after it the body of the organ, which also becomes inverted as it proceeds.

It is rare indeed that inversion does not go beyond this; for the considerable alteration in position and relations which has already taken place gives rise to sensations of discomfort and pain, and these react on the nervous system, inducing contraction of the uterine and abdominal muscles. Powerful and hurried expulsive efforts ensue, and soon the organ is

pushed beyond the vulva, where its own weight carries it downwards, and renders the prolapsus *complete*—the lining or mucous membrane having become external.

When inversion is complete, the uterus has the form of an enormous pear or calabash-shaped tumour hanging between the posterior limbs—the wider and rounded portion being inferior, and sometimes extending as low as the hocks; the narrow extremity or pedicle being at the vulva, in the interior of which, and between the labia and the tumour, is a more or less deep and circular cul-de-sac, according as the prolapsus has involved a certain extent of the vagina.

That the surface of the tumour is composed of the uterine mucous membrane is easily apparent from its softness and colour, which is sometimes a bright red, at other times somewhat violet or brown, according as it is much injected with venous blood, irritated by the external air, or by the litter, fæces, etc., with which it has come in contact, and which may be adhering to it. With the mare and sow the innumerable depressions for the reception of those of the fœtal placenta can be recognized; in the cow, sheep, and goat, there are the deep red, isolated, fungiform eminences or cotyledons, and in the bitch and cat the wide dark brown zone. Sometimes with the cow—more rarely with the mare — there are portions of chorion still attached to the placental surface of the uterus; and nearly always there are seen excoriations, more or less extensive ecchymoses, and even gangrenous patches, on the membrane —indications of the injury the organ has sustained, either during or after parturition. This mucous surface is not so sensitive as might be imagined; it is more or less hot, and bleeds at the slightest touch, though the hæmorrhage may not be profuse; at one side or the other may be noticed a kind of depression—the opening to the cornu which is not yet inverted.

The longer the period which has elapsed since inversion occurred, so the larger is the tumour. This increase is due to the violent expulsive efforts of the animal, as well as to the increase in weight of the organ, in consequence of the congestion and infiltration which have taken place in its textures; constricted—even strangulated—at its upper part, the circula-

tion is maintained with great difficulty, and the capillaries become gorged with blood. The walls lose their elasticity, become thickened, dense, and darker tinted, until, from its increased volume and altered aspect, the organ can scarcely be recognized; while its reposition is rendered extremely difficult, if not impossible.

From the very commencement, and even before anything is apparent at the vulva, the animal is uneasy and anxious-looking; it paws with the fore or stamps with the hind feet; switches the tail as if driving off insects; lies down and gets up frequently, finding no ease in either attitude; and strains more or less energetically at closer or wider intervals, thus adding to the extruded mass. Not infrequently the mare kicks at the prolapsed uterus, or endeavours to attack it with its teeth.

At first there is no perceptible fever, and the animal, in the intervals of straining, attentive to what is going on around, is solicitous about its progeny, and may even eat. This state is not of long duration, however; for soon after inversion is complete, indications of fever become manifest—quickened pulse and respiration, elevated temperature, and an expression of anxiety and pain. The straining is more frequent and energetic, and soon exhausts the animal; and the prostration, together with the great weight of the pendent uterus, compels it to assume and maintain the recumbent posture, in spite of attempts to make it get up. The organ assumes a gangrenous or intensely inflamed appearance, and the animal soon succumbs, either from the nervous prostration resulting from its sufferings or from the condition of the uterus.

Complications.

One of the ordinary complications of this accident is the adherence of the fœtal placenta to the uterine surface, though this is much more frequent with animals which have a multiple placenta—cow, sheep, and goat—than with the mare, ass, sow, carnivorous animals, or the rabbit.

The inversion of the uterus, when complete, also brings about displacement of the vagina; the deeper portion of this

part is found folded on the neighbouring surface of the cervix; the bladder and inferior wall of the rectum are also drawn into the middle of the pelvic canal, and occupy the place the uterus has quitted; the terminal portion of the urethra is doubled on itself, and so compressed that no urine can pass through it; while, the ureters continuing to carry that fluid to the bladder, this reservoir soon becomes greatly distended, without relief being possible. Hence results another source of suffering, and another cause of exhausting efforts added to those occasioned by the prolapsed uterus. In certain cases there may also exist prolapsus of the rectum, and displacement, or even inversion, of the bladder.

The uterus may also be wounded or torn, either from bad management during parturition or from injudicious attempts at reposition; or the injury may be due to rats, cats, dogs, or pigs gnawing at the bleeding mass; sometimes it is the creature itself, or a neighbouring animal, which inflicts the damage.

Contact with the air, and particularly with foreign bodies, induces inflammation, which frequently runs on to gangrene, and this to dissolution. Gangrene readily occurs in the sheep. Sometimes perforation of the vagina or uterus, arising at times from sloughing of a gangrenous patch, has caused fatal peritonitis; in other cases pelvic abscesses have formed.

After reduction has been effected, metritis and metro-peritonitis may appear; this is not at all unlikely in the mare. Lafosse mentions paraplegia also as a complication; this may be a consequence of gangrene and septic infection.

An exceptional complication is hernia of the intestines, through a rupture in the uterus. It may be noted that in prolapsus uteri in the mare it has happened that the colon has followed the fundus of the organ, and become invaginated in the inverted sac. Funk also mentions the case of a bitch in which one of the cornua became inverted, and prevented the expulsion of the remaining fœtuses from the other cornu; this necessitated the performance of the Cæsarian section. We have noticed a similar case.

Ayrault has on three occasions encountered an unusual

complication after reduction of the prolapsed organ, in the form of severe lameness, with knuckling over of the two hind fetlock-joints, but without any articular swelling. This complication disappeared as the animals recovered from the effects of inversion.

Prognosis.

There can scarcely be any doubt that, if no assistance is rendered to an animal suffering from prolapsus uteri, death must ensue, and more or less speedily; as gangrene is inevitable, while spontaneous reduction is impossible.

This condition is more rapidly fatal in the mare than in the cow. In some instances death occurs in less than twenty-four hours, but most frequently the animal may live from three to five days—very rarely longer. Sabini, an Italian veterinarian, cites a case in which treatment was not adopted until the seventh day; but this is an altogether exceptional instance.

Inversion of the uterus is generally fatal when owners of animals have neglected to procure assistance until too late, or who employ ignorant people to attempt reduction. If attended to sufficiently early by those who are competent, the number of recoveries is considerable, and perhaps in no other pathological condition is the utility and power of art, when invoked at the proper time, better demonstrated.

The prognosis is not equally favourable, however, in all the domesticated animals; and between the mare and cow, for instance, the difference is considerable.

With regard to the latter animal, Deneubourg, who has often had to treat this accident, never lost one of his patients. In 100 cases, Donnarieix has only had 3 deaths. Moens, in 27 cases, has not had a fatal termination. Guillaume, cited by Gellé, lost 3 cases out of 42; Loyer of Nemours, 9 out of 27; and Mazure, Holland, 1 in 4.

With regard to the mare, Donnarieix had 8 cases, and all perished; Cruzel had 3, and they also succumbed; Schaack only saved 1 of 2.

In 268 cases of prolapsus uteri in the cow, collected by Saint-Cyr, there were 35 deaths, or a mortality of 12 per cent. For the mare he only found 25 cases, and of these 17 were fatal—a mortality of 68 per cent.

A number of authorities quoted by Zundel give the percentage of recoveries in the cow as 97, and in the mare as 50.

It would therefore appear, and it is no doubt true, that this accident is much more fatal in the mare than in the cow.

Inversion in the sow is nearly always fatal, and often within twenty-four hours, unless amputation of the uterus is resorted to; but the bitch will live, in very rare cases, for two, three, or four days with the uterus prolapsed.

It has often been stated that inversion of the uterus leads to infecundity; but though it may do so in some instances, yet this cannot be accepted as a rule. Numerous cases are on record, and particularly for the cow and bitch, in which fecundation has taken place after this accident.

Though inversion is likely to recur after another birth, or even during a succeeding pregnancy, it is not invariably so; but to avert it care may be necessary.

Causes.

Inversion of the uterus generally occurs immediately after parturition, and is most frequent in the cow. It usually occurs within two or three days, rarely later.

Inversion of the uterus is absolutely incompatible with gestation.

In order that this inversion can take place, it is essential that the os uteri be more or less dilated; consequently the accident is only observed in breeding animals, and either during or soon after parturition or abortion.

In order that it can occur, a certain degree of relaxation of the uterine ligaments must be present; there must also be some cause of irritation in operation after the expulsion of the fœtus, sufficient to excite the contraction of the muscles of the uterus and lead to inversion, though it is often difficult to ascertain what this cause may be.

In very many instances pregnancy has gone on to its full term, the animal is strong and healthy, birth natural and easy, and there is nothing to indicate the advent of such an accident—when, suddenly, after a few expulsive efforts, the uterus is ejected in an inverted state.

It has been attempted to explain the occurrence of the

accident in such cases by alluding to the lymphatic temperament of the animals, and their consequent laxity of tissue; and it is often the case that cows which are "soft," and kept on food that is better suited for the production of milk than flesh, are the most frequent subjects of inversion—this sometimes occurring after each birth, though parturition was perfectly normal.

Difficult and laborious parturition, when much manipulation and energetic traction on the fœtus have taken place, has likewise been acknowledged as a cause of uterine inversion; and it is certain that the efforts to remove a fœtus which, whether from malposition, deviation of parts, excess of volume, etc., cannot be expelled in a natural manner, are somewhat frequently followed by this accident. But, on the other hand, how often does it happen that the most vigorous —even painful and violent—traction, and long and complicated manœuvres, are not succeeded by inversion; while, on the contrary, the easiest and most rapid birth sometimes is!

The retention of the fœtal placenta beyond the ordinary period must also be taken into account as one of the exciting causes; as it then acts as a foreign body, irritates the interior of the uterus, and so by a reflex influence induces contraction of its muscular layer, this giving rise to invagination of the extremity of one of the cornua, which is supposed to be the commencement of inversion.

It is also extremely probable that injudicious traction on the fœtal membranes may, for mechanical and physiological reasons, bring about this result in a flaccid and dilated uterus, when the cervix is also relaxed. More especially is this likely to happen if the placenta is adherent towards the fundus of the organ or in one of the cornua.

It is evident that several causes may be invoked to account for the accident. A flaccid, non-contracted uterus after birth, with a weak cervix and dilated os, and relaxed broad ligaments, may be looked upon as a predisposing condition; and this is most likely to be present in lymphatic animals, or those suffering from atony brought about by debility from disease, bad or insufficient food, exposure to weather, etc. When such a condition is present, it is easy to understand why inversion may occur from abdominal pressure on the cornua

or fundus of the organ, or from external mechanical force; and we can also comprehend why an antiperistaltic movement of one of the cornua, or a portion of it—just as happens in intussusception of the intestines—may take place sometimes immediately after birth, and before the cervix has had time to contract. Any trifling irritation may lead to this wrong movement, and once commenced it is far more likely to continue than to cease—as in the case of the intestines, when one portion becomes invaginated within another.

We believe this will be found to be the correct opinion.

Treatment.

Whatever may be the cause of inversion of the uterus, the obstetrist must lose no time in remedying the accident; as when interference is not prompt, a fatal termination, or, at the very least, serious consequences, will rapidly follow.

In treating it, several important indications are to be observed, but they may be classed as—(1) The *immediate* or *preliminary measures* which the local symptoms demand, (2) the *reduction* or *reposition of the uterus*, (3) the *retention of the organ*, (4) the *after-treatment;* should reposition be impossible or contra-indicated, then recourse must be had to (5) *amputation of the uterus.*

Preliminary Measures.—The preliminary measures consist in combating the local and general symptoms.

The animal is sometimes standing, sometimes lying down. If the latter, it must be got up; as the standing attitude is by far the best for reducing the inversion, there being more space in the abdomen when its walls are not compressed by the ground, and the obstetrist can operate more easily and quickly, while the downward inclination of the lower surface of the pelvis and abdomen is favourable for reduction and retention.

If it cannot be made to get up, or is unable to stand when raised, reposition must be effected while it is lying—fatiguing, and often troublesome, as the operation then is. This fatigue and difficulty may be somewhat diminished in raising the hind-quarters of the animal as much as possible, by means of bundles of straw placed under them—all the litter being

removed from beneath the abdomen, so as to relieve its contained viscera from pressure as much as possible. Cosse, Tyvaert, Haubner, Anderson, and others advise placing the animal on its back, with the croup so raised; while Viborg, Fässler, Bettinger, Obermayer, Hering, Merkt, Adam, and several other obstetrists, recommend raising or suspending it by the hind-limbs over a beam—a procedure which is most advantageous when reposition is possible or advisable. With the smaller animals—as the sheep, goat, sow, bitch, or cat—it is convenient to place them on a bench or table, and lying either on the side or back, with the hind-quarters well raised.

If the accident is recent—an hour or two, or even a little longer—the uterus may be returned at once; but should a longer interval have elapsed, it is well to ascertain the condition of the rectum and bladder, and to empty them if necessary, though it must be confessed that it is often a most difficult task to accomplish evacuation of the bladder. It may be done, however, by causing assistants to raise the uterus, then seeking for the meatus urinarius on its lower surface, near the vulva, and introducing one or two fingers into that canal, or a catheter through it into the bladder.

Should the fœtal membranes still be adherent to the uterine surface—wholly or partially—they must be carefully removed without injuring the cotyledons, enucleation being effected in the manner already described. If properly performed, this removal should not cause any hæmorrhage; and if any pulpy gangrenous cotyledons are found, it is better to remove them at once with scissors than leave them to be eliminated in the ordinary way, though if they show any vitality at all they need not be interfered with. Torn or gangrenous portions of mucous membrane are also to be excised in the same manner.

This done, the uterus should be cleansed from matters adhering to its surface, such as litter, mud, dirt, filth or blood, and carefully washed with an antiseptic lotion, such as boric solution, chinosol (1 in 1,000), etc.

The congestion and size of the organ may be reduced by injections of adrenalin into the mucous membrane at various parts.

Coculet's method of reducing the size of the congested uterus has been successfully employed on many occasions.

A dry and clean piece of linen, about a yard in length, and 28 to 30 inches wide, is passed beneath the inverted uterus and close up to the vulva; its lower border is then lifted over the organ, one of the ends folded over it, and the other end over this, so as to envelop the entire uterus—the four corners of the wrapper being uppermost. Tepid water is now kept incessantly applied to this cloth, which is gradually tightened every minute, by placing the open hand beneath the mass, and with the other hand pulling at the upper end of the wrapper. This equable, gentle, and sustained pressure over the entire organ in fifteen to twenty minutes brings about a marked diminution in its size, and renders its reduction easier.

Esmarch's india-rubber bandage has been suggested to overcome the uterine congestion in these irreducible cases, but there is no record of its having been tried.

If the uterus is torn, it may be necessary to close the wound by the continuous suture; but this must not be drawn too tight, mere apposition of the edges being all that is necessary. If the wound is not extensive, it need not be closed; indeed, there are many cases on record in which wounds of the uterus have not been sutured, the organ having been merely returned to the abdominal cavity, and yet recovery has taken place.

De Bruin recommends a solution of 2 per cent. alum, in order to reduce the size of the organ and to remove the slipperiness in manipulating the uterus.

Reduction or Reposition.—When inversion of the uterus is incomplete—a very rare occurrence—and the organ has not passed beyond the vagina, reduction is comparatively easy. It is sufficient, with the larger animals, to introduce the closed fist into the vagina, and to push the uterus as far into the abdomen as may be deemed necessary. When the animal strains, the operator must not push, but, maintaining what he has accomplished as well as he can, recommence as soon as the expulsive effort has ceased. Whether inversion is complete or incomplete, and if the animal is standing or lying, it is always well to have the hind parts higher than the fore.

When it is complete, then four assistants are generally necessary. One of these stands at the animal's head, and holds it firmly—if a cow, he may seize it by a horn with one hand and nasal septum by the other; if it is a mare, a twitch

on the nose or ear may be required, and it may even be necessary to have a side-line on one of the hind-limbs. Another assistant holds the tail over the croup with one hand, and with the other he presses or pinches the loins in order to diminish the straining; while a man stands at each side of the croup to aid in raising and returning the uterus. It is well to attract the animal's attention as much as possible, as it then offers less opposition to the manipulations, and does not strain so violently. Pinching the nose and loins will be found very effective in this respect, and, if a cow, a dog may be introduced in front of it. Should the animal be much exhausted or unsteady, two additional assistants may be required to stand at each side.

The uterus must be placed on a cloth or sheet and well moistened, the ends of the sheet being held by the two assistants at the croup, so that the organ may be lifted as high as the vulva. By doing so, there is neither traction nor compression on the mass, and, as the circulation in it is thereby much facilitated, the tumefaction subsides to a corresponding degree. It also allows the operator more freedom, as he could not sustain the weight of the prolapsed organ—which is sometimes as much as 100 to 140 pounds—and at the same time attempt its reposition.

When the animal strains very severely and continuously—as sometimes happens during reposition—it is useful to constrain the chest as much as possible by a girth, so as to prevent its expansion. In such cases reduction is greatly facilitated by a strong anodyne draught of chloral sufficient to produce semi-narcosis. Indeed, with the mare in serious cases it is most advantageous to administer chloroform in order to produce general anæsthesia before attempting to handle the uterus. Tracheotomy has been recommended to prevent fixation of the diaphragm for straining.

For effecting reposition, two methods are recommended, and these we will now notice—merely observing that, whichever be adopted, the operator always places himself directly behind the animal, with the inverted organ immediately before him.

First Method.—If the inverted tumour formed by the uterus is not very voluminous, then reposition may be effected by pressure on the fundus of the organ. This pressure is to be made by the closed fist against the central part of the tumour;

and in some instances, if it is well directed and the inversion not serious, the organ may be returned to the pelvic cavity by one push, while another will carry it into the abdomen.

Rainard and other practitioners approve of this method, and describe it somewhat in detail. The operator is to seek for the largest cornu—that which contained the fœtus—seize it by the fundus, and reduce this by pushing it inwards, as we would the finger of a glove which has been turned outside in—continuing the reduction by successive portions until the pedicle of the tumour is reached, when more serious resistance is encountered from the os uteri. This being overcome, the body of the uterus is next replaced, either by the fist pressing against the widest part. The pressure is to be directed straight forward, through the vulva and pelvic canal, upwards and inwards.

Great care is necessary in exerting the pressure, which should not be applied while the animal is straining. During expulsive efforts the operator must be content to wait, merely keeping the parts where he has carried them, until the straining has ceased. The pressure must be steady and well directed, so as not to bruise or lacerate the uterus. When a portion is got within the vulva, it is held there by one hand, while the other manipulates the next part to be returned. Reduction must be effected progressively, so that the organ may be completely replaced; if it is not, then reinversion is certain to occur.

Second Method.—If the uterine tumour is voluminous, and hangs heavily as low as the hocks, then the first method is dangerous, if not impracticable, and must not be attempted. The best method now undoubtedly is to return, first, *the parts of the organ nearest the vulva*, and not act directly on the fundus of the uterus until the greater portion has been replaced in the pelvis.

In order to accomplish this, the assistants on each side of the croup raise the uterus in the manner already described, so as to bring it near the vulva and opposite the axis of the pelvis. Then the operator gently presses with open hands at each side on the parts close to the vulvar opening, in order to force them gradually into it. By acting in this way with care and patience, and preventing, as well as he can, the expulsion of those portions he has already reduced, the

tumour by degrees becomes diminished, and may even be entirely returned. But it is not necessary to continue the method after two-thirds or three-fourths of the total mass has been carried into the pelvic cavity; for it is then more expeditious, and quite as safe, to apply the closed fist to the extremity of the tumour, and push it directly into the vagina and abdomen. In some instances it will be found that, towards the termination of reduction, the organ itself returns to its normal position, and often quite suddenly, as if it had been thrown forward by a spring.

Sometimes a combination of the first and second methods is most useful, an assistant pressing on the extremity of the tumour, while the operator manipulates near the vulva.

When the uterus has been returned to the abdominal cavity, the operator has then to ascertain if it is properly disposed. It sometimes happens that the extremity of one or other of the cornua remains invaginated in itself to a certain extent, and thus renders reduction incomplete; this will undoubtedly induce renewed straining, and in all probability bring about reinversion. It is therefore essential that the hand of the operator should carefully examine every part of the interior of the uterus and the genital canal, and particularly around the cervix.

This is more especially necessary when, after reposition has been effected, straining continues—a sure indication that the parts are not in their normal position. The hand must be again introduced, and if any abnormal folds of the mucous membrane—any commencing invagination—is encountered, they must be gently smoothed down or adjusted, not forgetting, should the cornua be involved, the very dissimilar disposition of these in the mare and cow.

When reposition has been finally accomplished, the straining ceases, and the animal soon appears to be quite easy; that is, if reduction is made early—on the same day, for instance—and provided there is no injury to the organ. It is generally advisable to keep the hand in the uterus for a short time until the latter begins to contract freely; if this is not done, the flaccid organ may again become inverted.

With the smaller animals, reposition is rendered difficult because of the pelvis not admitting the hand; and with some of them, and particularly the sow, reduction of the prolapsed

cornu or cornua is often a serious matter. The cornua must be reduced in the manner already indicated, the finger, or even a tallow candle, being employed to adjust them; then the body of the organ should follow; a small pessary with a handle, or retroverter, may be used to complete the operation. Frick, a Swiss veterinarian, has adopted a plan which has succeeded in his hands, and also with other obstetrists who have tried it. The inverted organ being reduced, the animal is raised by the hind-limbs, and a quantity of mucilaginous fluid is injected into the vagina and uterus until they are filled. This fluid acts in a mechanical manner, forcing the uterus to distend and assume its ordinary form.

It should be observed that reduction has been effected in large and small animals by elevating the hind-quarters until they are almost vertical, the weight of the uterus, with careful manipulation on the part of the operator, carrying it down to its normal situation.

Retention of the Uterus.—Reduction of the inverted uterus having been accomplished, and everything done to remove the slightest traces of invagination, the animal—unless serious injury has been inflicted on the organ—immediately begins to look easier and happier, and the inexperienced would suppose that there was no further occasion for interference. The experienced obstetrist, however, is well aware that certain precautions must be adopted against a possible recurrence of the accident. True, this recurrence is to a certain extent provided for by raising the croup of the animal as high as may be convenient, either by means of litter or boards, and keeping the forehand low. But this is not always a preventive, and veterinary obstetrists have therefore devised other means for retaining the uterus in its place until all risk of another inversion has passed away. These devices consist of *pessaries*, *sutures*, and *bandages*. If the animal is excited and continues to strain after reduction of the uterus it is advisable to administer a dose of chloral hydrate, for while under the influence of this drug straining usually ceases and very often by the time its effects have worn off she has forgotten her trouble and no further precautions are necessary to prevent a recurrence.

Pessaries.—These are instruments of various forms, which are introduced into the genital organs, and kept there for a

certain time in order to prevent displacement of the uterus after its reduction. There are several described which have been used by veterinary obstetrists.

Pessaries have been made of a round piece of wood 2 feet in length, to which is attached a round pad of tow (pad pessary); of an iron ring attached to a wooden stem (ring pessary); of an ordinary glass bottle; or of an indiarubber pouch and tube. The pessary is inserted into the uterus, and kept in position by attachment to some form of truss.

The value of pessaries in inversion of the uterus in animals has been a good deal discussed. We are not aware that they have been much, if at all, employed in this country; and in Germany they do not appear to have obtained much favour; while in France, though they have often been resorted to, yet their use has been only limited, as their practical utility has been questioned by many excellent obstetrists.

It has been pointed out that, if they can be supported without inconvenience by some phlegmatic, unimpressionable animals, more frequently they irritate the organs in the pelvis, cause straining and uneasiness, and produce those relapses which their application was intended to avert. Therefore it is that, nowadays, they are hardly, if ever, used at all.

Saint-Cyr admits that if, in some exceptional case, it is necessary to employ a pessary, the *pig's bladder* deserves the preference for the larger animals. It is found nearly everywhere, requires no other preparation than merely softening its texture by pouring some tepid water into it, whilst its outer surface can be well oiled. It is easily placed where desired, even in the uterus; its soft, flexible walls cannot bruise or excoriate; and, by inflation, it can be distended to the size necessary for each particular case.

Sutures.—The suture is generally preferred to the pessary, as being simpler, more easily applied, and having fewer inconveniences than the latter. Being inserted outside the genital organs, they do not irritate those which are most concerned in inversion, neither do they provoke expulsive efforts on the part of the animal.

The sutures may be of hemp, silk, or metal; and they may be passed directly through the lips of the vulva, or include the skin towards the point of the hip, on each side. The first may be named the *labial suture*; the second, the *hip suture*.

The *labial suture* may be "interrupted," or "quilled," and is made according to the principles of surgery. A saddler's large needle, or a sacking-needle with a handle at one end and an eye near the point, is the most useful. Through the eye is passed a piece of whipcord, two or three strands of well-waxed thread, or a piece of cotton or silk tape, or moderately thick carbolized catgut. The needle is passed through one lip of the vulva—say the right—from the outside, and near the *upper* commissure; it is then passed through the left lip, from within to without, towards the inferior commissure. It is then cut from the suture, sufficient of the latter being left for both ends to tie in the middle of the vulva. A second suture is placed in the contrary direction—upper part of left to lower part of right lip—so that the two sutures cross each other obliquely, in an **X** fashion. The ends are now tied toward the centre of the vulva; and, if thought necessary, a third suture, directly transverse, may be placed between these.

It is more convenient and painless to pass the needle first through the tissues, then the suture through the eye of the needle, withdrawing the latter, which carries the suture with it.

This *labial* suture is painful, as it is placed in textures already swollen and sore, and it does not always retain a sufficiently solid hold to prevent the uterus tearing it out when the straining is very severe and violent. The *hip suture* has therefore often been resorted to in these cases, and with advantage. The needle—either the above or a small seton needle—is passed through a fold of skin lifted up at the point of the hip or ischium, on a level with the upper commissure of the vulva, and carried across to the other hip. The next suture is a trifle lower, and the others below this—there being in all about four to six sutures, the ends of each being tied in the middle or fastened to bits of round wood at each side. In this way the vulva lies in front of a number of strong cords, their strength and durability being in proportion to the width of skin they are made to enclose. The sutures may be drawn more or less tightly, and they may either be transversely parallel or cross each other obliquely.

When the animal is not pregnant, the vulva is not nearly on a level with the ischial tuberosities. After parturition, however, it is swollen and prominent, and projects beyond these parts. It will therefore press against the hip sutures,

and may even become excoriated or cut by them; so that, to avoid injury and diffuse the pressure, it is well to place a thick pledget of tow or other soft material on each side of the vulva, on which the sutures may chiefly rest.

Though good service has been obtained from these sutures in a number of instances, yet many practitioners prefer the *metallic* suture. This may be of lead, or iron wire softened. The needle is like that used for the other sutures; a pair of wire-pliers is necessary, and two sizes of wire are recommended. The thickest size is cut into pieces of a convenient length, and an eyelet turned at one end, while the other is made into a hook. The left lip of the vulva is seized by the left hand, and the needle pushed through it from the outside, a little obliquely upwards, so as to bring it out above the superior commissure;

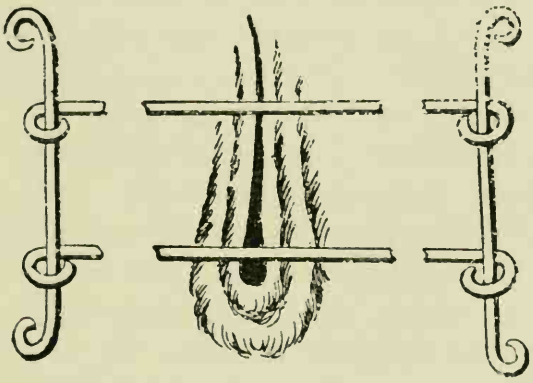

FIG. 157.—ZUNDEL'S LABIAL SUTURES.

the wire is passed into the eye at the point, and the needle being smartly withdrawn, the wire is pulled through. The needle is introduced into the right lip in the same manner, but downwards, and the wire pulled through it. The hooked end is now passed into the one with the eyelet, drawn sufficiently through, cut off, and the end bent also into an eyelet, the suture constituting an ellipse at this part, which is opposite the vulvar opening. Beneath this suture one or two more are placed, and all are joined together by the thinner wire, which, doubled, is longer than the space occupied by the sutures; each piece is passed into each eyelet of the upper suture, and firmly crossed and twisted as far as the two points of the suture; the same is done with the second and the third suture—the whole being joined into a solid piece, which does not interfere with the physiological functions of the animal.

The same objection applies to wire sutures through the vulva as to vegetable sutures; but there can be no doubt that they are less painful and more effective when passed through the skin at the point of the hip. Two wires across are generally sufficient; the ends are bent round by pliers after they are inserted, and through these eyelets on each side a vertical wire is passed (Fig. 157). This keeps the horizontal wires together and in place.

Metallic sutures in the form of pins, screwed at one end to fix into plates after being passed through the labia of the vulva, and other contrivances of this description, have been described; but in principle they are all the same, and there is no manifest advantage in their employment. Other methods of applying sutures have been described in the treatment of ante-partum prolapse of the vagina.

FIG. 158.—THE LOOP OF DELWART'S TRUSS. (FRANCK.)

In fact, it may be said of all the labial or other sutures, that they in no respect prevent the inversion of the organ internally, but merely hinder its escaping beyond the vulva; and as their utility depends not only upon the material of which they are composed, but also upon the integrity or power of resistance of the textures through which they pass, it often happens that they either give way or they "tear out" prematurely, leaving sometimes troublesome wounds or cicatrices.

West's clamp has also been applied to the lips of the vulva with success. It may be made of iron or aluminium, and in various sizes, for cow, mare, sheep, pig, etc.

Bandages or Trusses.—To dispense with the inconveniences of the pessary and suture, the *bandage* or *truss* has been proposed and extensively employed; and in the great majority of cases of uterine inversion it should be adopted in preference to the other methods of retention.

The truss or bandage may be composed of cords, surcingles, leather, canvas, etc., which are so arranged and disposed as

to make pressure upon the sides of the vulva, and, by keeping it closed, prevent the extrusion of the uterus without interfering with defecation or micturition.

There are several kinds of truss in use, and these vary somewhat in their details, though in principle they are the same. Some of them are fixed around the shoulders and neck, others round the chest only, and others, again, round both regions—most frequently to a collar or surcingle. Allusion will be made to those which are recognized as most valuable.

Two of the most useful and readily-made trusses are composed of light rope or thick cord—something like a clothes-line. One of these is termed "Delwart's truss," and is formed by cords united by a loop in their middle, in such

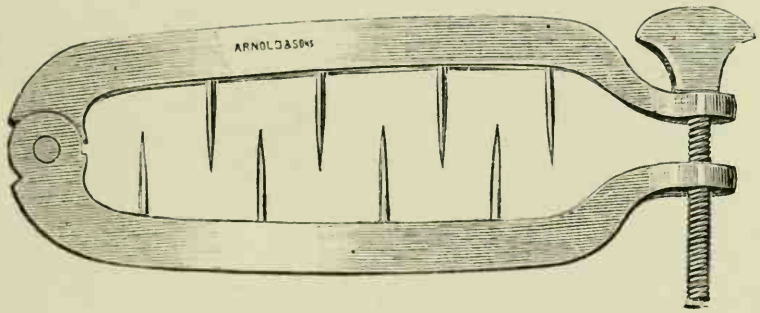

FIG. 159.—WEST'S CLAMP.

a manner that an oval space (Fig. 158, *a*) sufficient to admit the vulva, and compress it laterally, is formed—the inferior commissure being left free, to allow the escape of urine, and uterine discharges, should there be any. The two portions of one of the cords (*b b*), passing over the back, are secured to a collar or band round the neck or chest; while those of the other cord (*c c*) pass between the thighs, and are tied to the lower part of the collar or surcingle, in the manner depicted in Fig 160. The loop may be wrapped in tow or cloth, to prevent chafing to the parts under the tail.

Another rope truss, described by Renault, is perhaps more simple than, yet quite as effective, as the preceding. This is composed of a leather strap which buckles round the neck, and a rope from 24 to 30 feet long—the thickness of the little finger, or a trifle less, according to the size of the animal. The neck-strap is not indispensable, though it is

useful in giving more firmness to the truss; it may be replaced by a thicker rope, or in the case of the mare by an ordinary draught collar.

In order to apply the bandage, the neck-strap or collar is first to be put on; the cord is then to be doubled in equal parts and put across the back, behind the withers, so that each portion may fall behind the shoulders, to be passed under the chest. In front of the chest, the two portions are crossed, the left passing to the right and the right to the left.

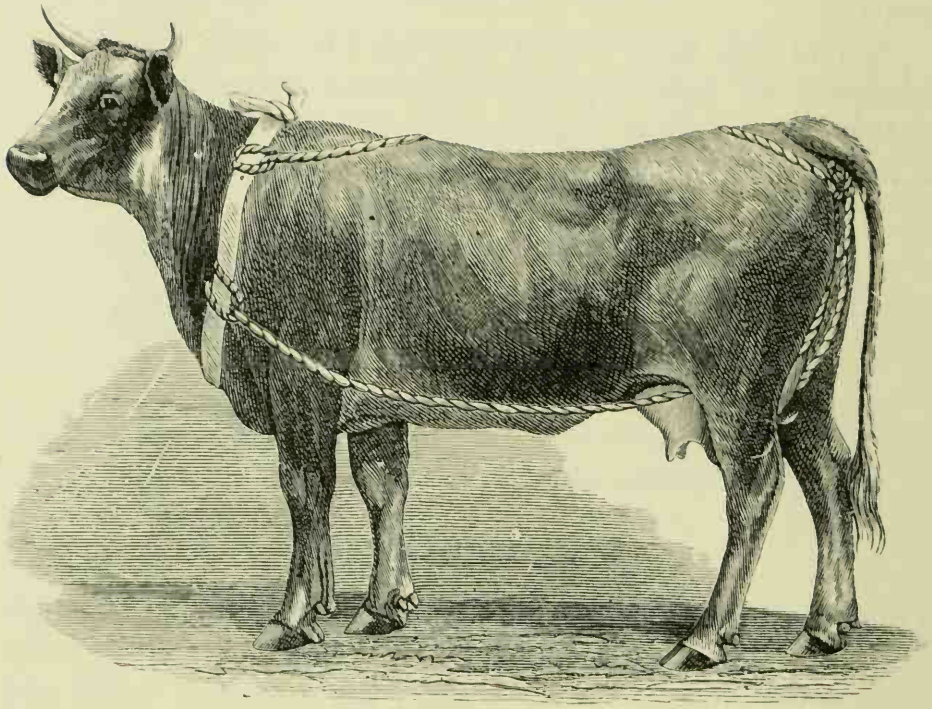

FIG. 160.—DELWART'S TRUSS APPLIED. (SAINT-CYR.)

Each side is carried through the collar, and back over the front of the shoulder, at the top of which both are tied in a simple knot, so as to be easily untied when required. At 10 or 12 inches from this a firmer knot is tied, then several others beyond it towards the loins—according to the length of the animal—and at nearly equal distances as far as the root of the tail, where a simple knot is tied. The branches of the cord then separate on each side of the vulva, and unite again by a simple knot below the inferior commissure; again separating, each cord is carried between the hind-legs, brought up by the flank towards the loins on each side, and tied over

the back to one of the loops there, as shown in Fig. 161. This truss can be made as easy or tight as may be necessary; its simplicity is its great recommendation.

A very efficient and suitable truss is that made of a piece of stout leather, with a round opening in it above, corresponding to the anus, and an oblong opening beneath this, through which the vulva passes. The leather is so shaped as to embrace and lie close to the root of the tail and between the buttocks, extending for some distance below the vulva, as in

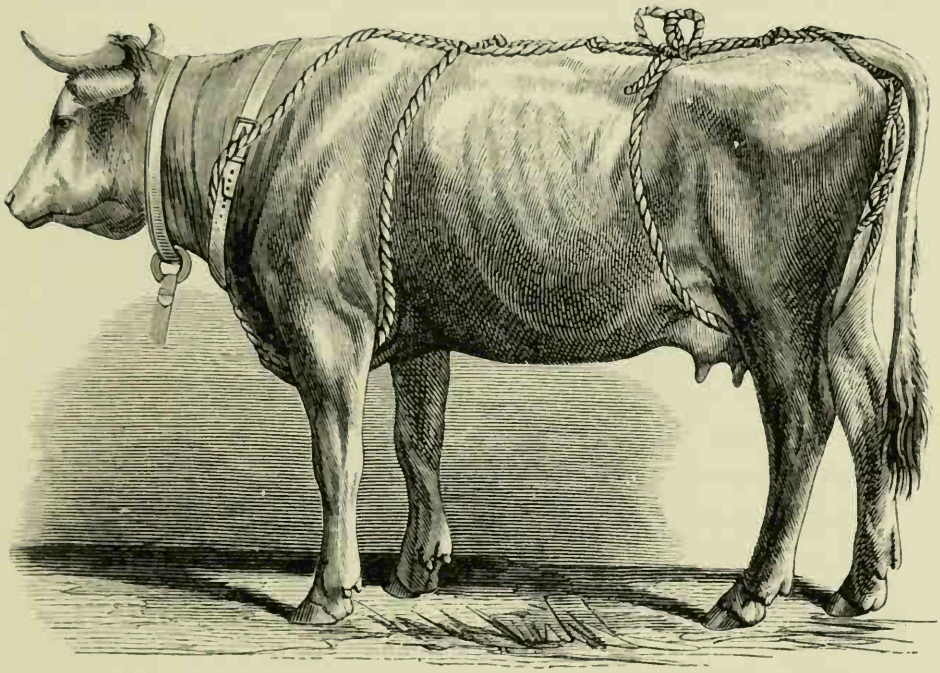

FIG. 161.—RENAULT'S TRUSS. (SAINT-CYR.)

Fig. 162. It is maintained in position by four strong leather straps—two above and two below—which pass on each side to a surcingle around the chest, which may again be attached to a collar or breast-strap, should the straining be violent.

Another kind of truss is formed by an ordinary crupper attached to a surcingle, and, if need be, this to a breast-strap or collar. From the part of the crupper under the tail proceed two, three, or four narrow leather straps, which, passing over the vulva, are attached to the loop of a doubled rope in the perinæum, each portion of the rope being passed between the hind-legs and tied to the lower part of the surcingle. Or a cord may be attached to the crupper at each side of the

vulva, and carried forward between the hind-legs and underneath the belly in the same manner, two or three tranverse narrow straps passing between the two, immediately over the vulvar opening.

When there is much swelling, a soft cloth doubled several times, or a sponge steeped in cold water, may be placed over the vulva beneath the straps, though in such a way as not to interfere with micturition or defecation.

Various other trusses for the mare or cow have been proposed by veterinary obstetrists, but in principle they are all the same. We need only notice one of these, which has been proposed by Lund, a Danish veterinary surgeon, and which

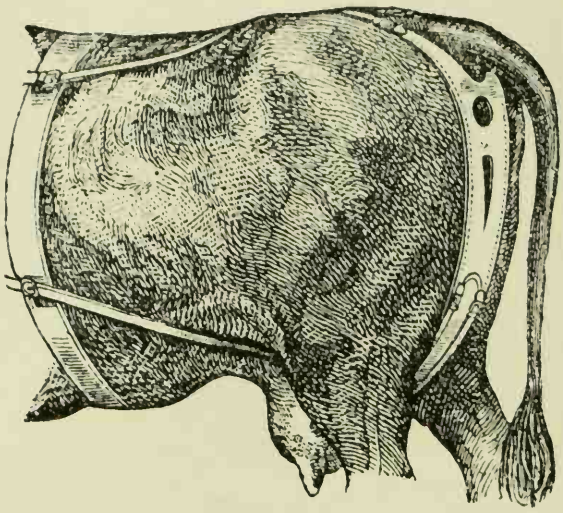

Fig. 162.—Leather Truss. (Franck.)

has been greatly lauded by Dieterichs and others for its cheapness, simplicity, and efficiency. The chief part of it is a narrow piece of iron, 9 millimetres thick (about one-third to three-eighths of an inch), welded at its extremities, and turned into a triangular shape that enables it to include the vulva, while the loops at its three corners allow it to receive cords (Fig. 163). The base of the triangle, which fits under the tail, is about 2 to 2½ inches wide, and the sides from 5 to 7 inches long. The loopholes at the angles may be replaced by small hooks to receive the cords.

This metal plate—which may be of round iron and convex on one side, concave on the other—fits over the vulva and the base of the tail, the apex being below the lower com-

missure, while the convex side is towards the animal. Cords pass through the loops or around the hooks, one above, another below—as in Fig. 164—and are fastened to a surcingle or collar, or both, like the preceding trusses. Any blacksmith can make the plate in a few minutes; and from what has been said in praise of this cheap and simple method of retaining the uterus, there can be no doubt that it will be found most useful.

All these trusses are intended for the larger animals, and cannot well be applied to the smaller creatures, with the exception perhaps of Lund's plate, which, much diminished in size and made of a piece of strong iron wire, might be serviceable for the ewe, sow, goat, or large bitch. For small animals Rainard recommends a bandage made by folding a piece of strong cloth in a triangular manner. The base of this triangle lies over the loins, is carried down the flanks to beneath the abdomen, where the corners are tied; the apex of the triangle is passed over the croup and vulva—a hole being made for the tail to pass through, and another for the anus—brought between the hind-legs, and either by means of tapes attached to it, or, if sufficiently long, by splitting up the end to a short distance so as to make two strips of it, fastening the piece to the ends already tied beneath the belly.

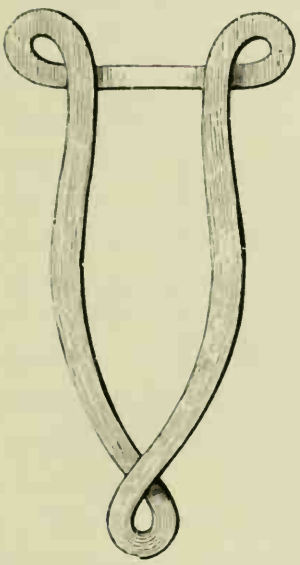

Fig. 163.—Lund's Truss Iron.

It must be acknowledged that these trusses, no matter how skilfully they may be contrived or however well they may be adjusted, will not hinder vaginal inversion of the uterus; all they can do is to prevent the organ from being suddenly protruded beyond the vulva again, and so exposed to the air and the irritating effects of extraneous matters before it can be returned once more. This alone, however, is an important object achieved, and is a great step towards permanent retention. Besides, by maintaining the labia of the vulva in

close apposition, the truss, if well applied, prevents the admission of air into the genital canal, and thus does away with one source of irritation. And as the apparatus does not cause any pain or inconvenience to the animal, it is to be preferred to any other means for retaining the uterus.

With regard to the best kind of bandage, this is of secondary importance to its proper application. Simplicity and efficiency are the desiderata, and these will be found, we believe, in the

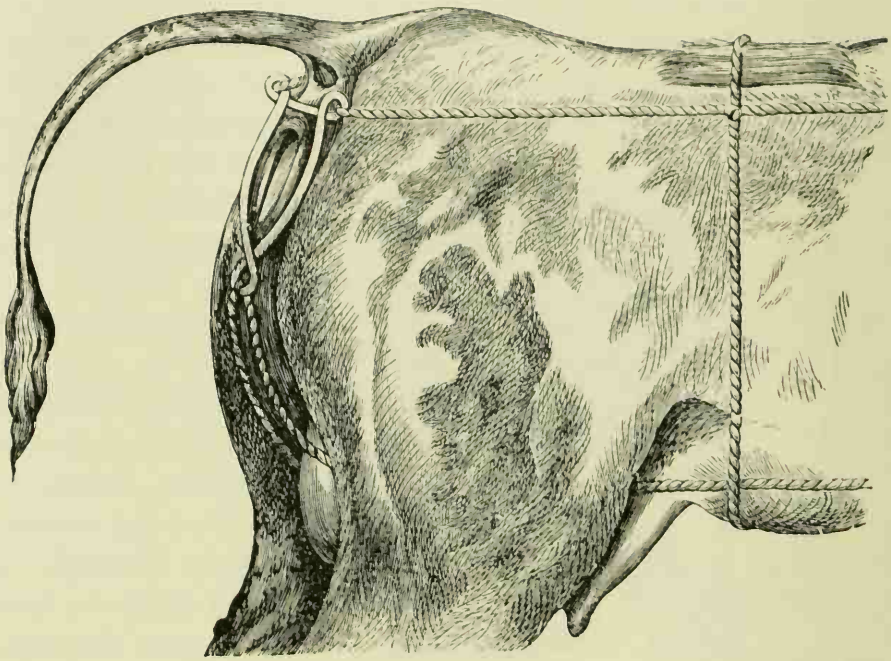

FIG. 164.—LUND'S TRUSS APPLIED. (SAINT-CYR.)

trusses we have described, and particularly in those of Renault and Lund.

If reposition of the uterus is properly effected and the truss well applied, there is little reason to apprehend a recurrence of the accident.

After-Treatment.—When the uterus has been returned to its natural situation, an antiseptic injection or "swabbing" of the interior should be carried out, and precautions against a recurrence of the inversion adopted; then little more remains to be done except to observe some simple directions, which are to be followed for a few days after reposition.

If the weather is favourable, and little or no fever present, the animal—covered with a rug—should be walked about for

a few minutes, as this takes away its attention from the accident, regulates the general circulation, and allays the expulsive efforts.

The animal should stand with the hind-parts well raised.

Great attention should be paid to the diet, particularly with ruminants, from their tendency to tympanites and constipation. Indeed, tympanites may be sometimes considered a cause of inversion in the cow and ewe; and the rumen is at times so distended with gases, and so proves such an obstacle to reduction, that it has to be punctured in the usual way before reposition can be effected. For the same reason, this inflation of the digestive organs has to be guarded against in the after-treatment. For the first day only oatmeal gruel with barley-water—both tepid—should be allowed in small but frequent quantities. For some days, easily-digested, sloppy food may be given, and if the appetite is fickle it should be tempted by choice portions of diet, though the quantity must not be large at any time until all danger is past.

It is advisable, in all cases in which the mucous membrane has been injured or exposed to the air for some time, to inject some antiseptic fluid, such as boric acid solution, into the uterine cavity for two or three days, or to insert antiseptic pessaries.

Should there be a tendency to constipation, soap-and-water enemas may be administered.

Micturition is rarely deranged; but if no urine is passed within twenty-four hours after reposition, an examination should be made, and the bladder emptied in the usual manner. The different disposition of the urethral valve in the mare and cow will, of course, be borne in mind in passing the catheter.

Nearly always these simple measures suffice to restore the animal to its usual condition in three or four days, in uncomplicated cases. In exceptional instances, however, metritis, metroperitonitis, or leucorrhœa, will follow the accident. The animal may go off its milk and fall into low condition, without exhibiting any acute symptoms. Sometimes the animal remains sterile for a variable period. With the ewe, chronic inversion of the uterus often leads to loss of the wool.

In complicated cases there may be wounds, lacerations, rupture of the uterus, cornua, or vagina, lesions of neighbouring organs or textures, etc.; these will be referred to hereafter.

In the bitch, where the uterus is being constantly returned, and is still fairly normal, laparotomy is recommended, and the fixation of the uterus to the abdominal wall.

Amputation of the Uterus—Metrotomy.—The removal of the uterus is indicated—(1) when the operator is baffled in his attempts at reduction; (2) when the extruded organ is so injured by lacerations or bruises, or when the organ has become so softened and gangrenous, that it would be certain death to the animal to replace it in the abdomen; (3) when inversion recurs several times after the uterus has been completely or incompletely returned to the abdomen, in spite of all attempts at retention. This recurrence leads very often to the laceration, bruising, and gangrene, of the organ. With certain animals, such as swine, reposition is extremely difficult, particularly when one or both cornua are inverted, as the smallness of the organ as well as the narrowness of the pelvis is a great obstacle to manipulation.

The operation was performed by Jenne, a German veterinarian in Forchheim, as far back as 1802.

Although a most formidable and painful operation, it has been tolerably successful. Saint-Cyr notes that in 30 cases 23 animals recovered. Franck refers also to 30 cases, 18 of which recovered. Of these, only 1 was a mare; 17 were cows; 3 goats; 4 sows; 1 ewe; 2 bitches, and 2 cats. Probably the operation would be more successful if it were resorted to earlier, before the patient is greatly exhausted.

Occasionally some cows which recovered showed signs of œstrum, while other cows have yielded milk for a long time; in one case, recorded by Lecoq, for two years afterwards.

Operation.—With the larger animals, the hind-limbs should be secured—especially with the mare—or the animal may be thrown down or fixed in a travis.

Chloroform, chloral hydrate, or morphia, should be administered to the animal about to be operated on, to act as an anæsthetic or anodyne. All antiseptic precautions must be taken. The uterus must be washed with an antiseptic solution, and then tied up in a large sterilized cloth, so that it may be

easily moved about by the operator or his assistants. The volume of the tumour should be reduced by compression to send back into the general circulation the immense quantity of blood contained in the organ. For this purpose the method of Coculet, already described, or Esmarch's method, should be employed. An exploratory incision should be made in the wall of the body of the uterus, and if any intestine or viscus is found in its interior, this must be returned to the abdomen before amputation is ventured upon.

The amputation should be carried out as near to the vulva as possible, but without including the meatus urinarius. In the large domesticated animals this would occur near the cervix uteri; in some small animals it may include only one of the horns. It may be effected by ligature or suture. One may use for this purpose silk, tape, or whipcord.

This is placed around the pedicle of the tumour, tied with a running knot, and gradually but firmly tightened by pulling at each end, so as to completely intercept the circulation in the organ, and afterwards securely tied. The ligature must be very secure and tight, to prevent subsequent bleeding, and also to insure that it will not slip off, and so expose the peritoneal cavity to infection. To make certain that this will not occur, it may be supplemented by a double ligature, as recommended by Rainard. A needle threaded with a double piece of cord is passed through the middle of the pedicle from above to below, and then cut away from the cord, which is thus divided into two halves. One of these is very firmly tied round the right half of the pedicle, the other round the left.

Another ligature used is the elastic ligature. A long piece of india-rubber tubing is applied around the pedicle, and tied firmly there. The tissues are cut through by the continuous pressure, which causes obliteration of the vessels and cessation of nutrition. This method is very successful.

Multiple ligation has also been recommended. By whatever procedure the pedicle of the tumour is rigidly compressed, the uterus has afterwards to be excised with the knife about two or three inches behind the constriction. The portion of vagina or cervix remaining should then be returned as far as possible into the genital canal. The canal is washed out

daily with a mild antiseptic lotion. The ligature and the tissue behind it sloughs away in from six to ten days. Usually cicatrization is completed in fourteen days.

Amputation of the uterus with the ecraseur has also been carried out. The chain may include the whole or only a portion of the pedicle at the one time in crushing through the tissue. This method, however, is accompanied with grave risk, as the abdominal cavity is opened and the intestines may escape, or the peritoneum become infected.

In some cases the animals do not appear to be much disturbed after the operation; in others they are very uneasy. Ledru describes an instance in which the cow, after the operation, was for an hour as if mad. It lay down, got up, rolled about, kicked and stamped, and climbed into the manger. The eyes appeared to be starting from their orbits, and it was dangerous to approach. These symptoms gradually subsided, and the animal ultimately recovered. After the operation the cows appear to have fattened well, and, when killed, large masses of fat have been found in the place of the uterus, filling the pelvis.

In several fatal cases the intestines have been involved in the prolapse, and have been amputated with the uterus.

INVERSION OF THE VAGINA—INVERSIO VAGINÆ.

Inversion, prolapsus, or fall of the vagina has already been described as an accident of pregnancy. Most frequently after parturition this condition is witnessed when delivery has been difficult and protracted. It is caused in a similar way to antepartum prolapse. It is more commonly noted in animals, such as dairy cows, which are confined to the house, are not given exercise, and are highly fed. A very common cause is some irritation of the genital passage, a metritis or vaginitis, following upon parturition, which induces straining. The relaxed condition of the walls of the passage also predisposes. It may take place after abortion and retention of the placenta.

Simple inversion of the vagina during pregnancy disappears spontaneously after pressure, but that occurring after birth has no tendency to spontaneous reduction.

The **Symptoms** are similar to those of antepartum inversion of the vagina, but are usually more severe. It is distinguished from prolapse of the uterus by the fact that there are no traces of cotyledons or placental follicles. There is generally some difficulty in micturating, arising from pressure on the urethra. Even paralysis and rupture of the bladder have been noted as a result.

Inversion of the vagina has been mistaken for a cyst or inversion of the bladder, and in the bitch for a condylomatous tumour; but careful examination should be made to avoid such errors.

Prognosis.—Inversion of the vagina is not nearly so serious an accident as inversion of the uterus, and cows, mares, and bitches, may often suffer from this condition for months without showing much inconvenience. It is liable to recur; reposition may be readily effected, but no sooner is it accomplished than inversion again takes place through the animal straining.

In many cases the prolapsed organ becomes lacerated, excoriated, and thickened, and new adhesions are formed which fix it in an abnormal position. The animal gradually loses condition and becomes emaciated. In a few cases the inflammation extends to the uterus, and the animal dies almost as rapidly as from inversion of the uterus.

The more speedily treatment is resorted to after inversion has occurred, the more easily is reduction effected, and likely to prove permanent, while the risks from injury are greatly diminished.

Treatment is similar to that described for antepartum prolapse. If the fœtal membranes are still in the uterus, then they should be removed, as their presence is certain to cause expulsive efforts, which will inevitably lead to protrusion of the vagina again.

For retention of the reduced part, Harms and Schleg employ *ringelns*. Schleg's ring is a thin flat band of steel, pointed at one end, and with a round hole and slot a little above the point; at the other end is a kind of button raised on the surface. The point is passed through the labia, and the band bent round so as to meet and button at the ends. The ring has been worn, according to Schleg, from a few days to more than five months.

Occasionally the accident has proved so troublesome, and retention has so baffled every attempt after reduction was effected, that amputation of the protruded portion has been practised, and with success. The procedure is similar to that for amputation of the uterus.

INVERSION OF THE BLADDER—PROLAPSUS VESICÆ.

We have already described inversion of the bladder as occurring before parturition. The description there given is appliable to the accident when it follows delivery. It is rather rare, and is most frequently met with in the mare and cow. Reduction has been accomplished successfully in the mare two months after parturition, when the accident happened.

In desperate cases, when reduction cannot be effected, or when the organ is so much injured that reposition is almost certain to be followed by death, amputation has been tried. A ligature has been applied around the neck of the bladder on the fundus side of the ureteral openings, and the body of the bladder, about an inch from the ligature, cut away with the knife. The rest of the bladder is returned to its original position. The objection to this operation is that, even if the animal recovers, the urine will, generally, ever after drip continuously from the vulva and run down the thighs, excoriating the skin.

TRAUMATIC LESIONS OF THE GENITAL AND NEIGHBOURING ORGANS.

Either during or after parturition the genital and neighbouring organs are exposed to injuries of a more or less serious character, according to their situation and extent.

1. **Laceration and Rupture of the Uterus** are not uncommon accidents during parturition, and particularly in the mare and cow; they may occur spontaneously. Then the predisposing cause is some defect in the texture of the uterus, or energetic contraction of the uterus upon some projecting portion of the fœtus, such as one of the extremities. It may also arise from undue pressure on the brim of the pelvis or on exostoses in or upon the bony canal.

Most frequently the accidents arise from artificial mechanical causes, brought into operation in the course of manœuvres for affecting the extraction of the fœtus in dystokia. Rupture may take place during retropulsion, version, or correction of the direction of extremities. The various instruments employed may slip during traction, and tear or incise the uterus. This may also occur from improperly directed traction when the fœtus is in a wrong position. The jagged ends of bones cut through in embryotomy may also cause rupture. After parturition, rupture and laceration may be produced by direct injury upon the prolapsed organ or by pessaries introduced into the genital canal to retain the inverted organ.

The injury varies in extent from an abrasion of the mucous membrane to a rupture through the mucous, muscular, and peritoneal coats. Usually the rupture contracts after infliction, and is often on that account difficult to find. Sometimes the rupture is so large that the fœtus enveloped or not in its membranes passes entirely through it into the abdominal cavity. Incomplete lacerations occur chiefly at the cervix, and are usually longitudinal.

Diagnosis.—In all these cases when the organ remains *in situ*, the diagnosis is difficult, and generally it is only on post-mortem examination that the lesion is discovered. Manual examination of the uterus may reveal it, and should always be carefully made by the veterinarian as a preliminary measure in dealing with a case of dystokia.

Non-perforating lacerations do not, as a rule, give rise to very marked symptoms immediately, though subsequently they may produce metritis or metroperitonitis and septic infection.

In complete rupture certain clinical symptoms may appear which might lead to suspicion of the existence of rupture. Thus, the expulsive efforts are very energetic and regular up to a certain period, when all at once they cease, and the animal begins to manifest symptoms of abdominal pain. Sometimes the cow opens its mouth and protrudes the tongue, extends the head, and utters a moan or grunt at each expiration, but does not strain.

In inversion of the uterus, the rupture is easily recognized on inspection.

Prognosis.—This is always an extremely serious condition, and, if the rupture is complete, usually fatal. It is more hopeful when the laceration is on the roof than on the floor, and when the os closes rapidly to exclude infection.

The chief danger is peritonitis or metroperitonitis. This is almost certain to follow if the rupture is complete and lies on the floor, because the fluids in the uterus pass through the rent into the peritoneal cavity. In incomplete rupture the peritonitis may occur as a secondary infection to a metritis, or it may afterwards become complete through gangrene and sloughing of the tissues in the neighbourhood. Occasionally, also, *hæmorrhage* results from the rupture. This has already been described.

Hernia of the intestines occurs sometimes when the rent is large, and the uterus is so flaccid and uncontracted that it allows the opening to remain patent. In some instances the intestines have passed through the uterus, vagina, and vulva, reached the ground, and the animal has trodden upon them, thus hastening death ; occasionally the hernia has been reduced and the creature survived.

Treatment.—Only when the uterus is prolapsed can the rupture in it be sutured. In the other cases the fœtal membranes and fluids or blood-clots, if present, must be removed. Antiseptic fluids must not be injected, but the cavity should be mopped out with a pledget of cotton-wool or tow soaked in some antiseptic lotion (such as $\frac{1}{2}$ per cent. carbolic acid or lysol). Straining, if present, may be subdued by doses of anodynes, such as chloral hydrate, and hot cloths over the loins. If there is hernia of the intestines, these must be promptly returned into the abdominal cavity.

When the fœtus has passed through the rent into the abdominal cavity, delivery *per vias naturales* is then impossible, and Cæsarian section must be resorted to.

2. **Laceration and Rupture of the Vagina.**—Of all the domestic animals, the mare appears to suffer most frequently from lesions of the vagina during parturition. This may be referred to the energetic and rapid contractions of the uterus and the length of the limbs of the fœtus. Trifling laceration of the vagina and vulva is often observed in primiparæ, because the genital passage is narrow or rigid.

The causes of these injuries are similar to those stated for rupture of the uterus.

If the anterior portion of the vagina is ruptured, the same results may take place as in rupture of the uterus, with which it is sometimes complicated. The abdominal cavity is opened into in complete rupture of the anterior portion of the vagina. Because the walls of the passage are less contractile than those of the uterus, hernia of the intestines or bladder is more liable to occur. Wounds of the vagina and uterus are very liable to infection, especially in the bitch and cat. Hæmorrhage is generally not so much to be dreaded as in lacerations of the uterus. In the posterior part of the vagina a wound may be followed by pelvic cellulitis from infection of the surrounding connective tissue; sometimes a small sinus results.

Much constitutional disturbance is generally only manifested when the lesions are serious or when septic infection has taken place. Small rents may not give rise to any perceptible derangement, except, perhaps, a little fever and tumefaction.

The *Treatment* is similar to that of rupture of the uterus. If the rent is large and can be manipulated, sutures may be applied after having cleansed and disinfected the tissues. In all cases the vagina must be kept perfectly clean and swabbed out daily with weak solutions of carbolic acid or other non-irritant antiseptic or dressed with some antiseptic preparation such as B.I.P.P.

Recto-Vaginal Fistula.—Injuries to the rectum are generally produced through the wall of the posterior portion of the vagina, during the passage of the fœtus. When the salient parts of the latter, and more especially the feet, are misdirected and pressed up towards the sacrum of the mother, and if the rectum chances to be distended with fæces, not only the vagina, but this viscus also may be perforated, and some portion of the fœtus soon appears at the anus. If this accident is discovered in time, it may be possible to push back the parts thus misplaced into their natural channel, and complete delivery by the vagina; but notwithstanding this happy termination, the communication between the vagina and rectum very often remains permanent, and a recto-vaginal fistula is established.

The treatment of these cases is not always satisfactory, so far as a perfect cure is concerned. Sutures have sometimes

been employed to close the wound in the rectum, when accessible. But this surgical operation can rarely be resorted to, and all that may be done is to keep the lacerated parts clean, by frequent injections *per vaginam* and *rectum*, prevent constipation, and treat the injury on ordinary principles—not forgetting the free employment of antiseptics.

If sutures are employed to close the fistula, they may be supported by a pessary or tampon placed in the vagina, beneath the fistula.

When the limbs or other parts of the fœtus protrude through the anus, it is nearly always advisable to amputate them, in order to move the body more easily in the vagina, and with less risk of further injury to the parent. Once in the genital canal, then the fœtus can be extracted in the ordinary manner.

Rupture of the Perinæum.—Laceration of the vagina is not at all infrequently complicated with more or less extensive rupture of the perinæum, and occasionally rupture of the vagina, rectum, and perinæum, may be met with in the same animal. Sometimes it is only the *fourchette* and superior commissure of the vulva which are involved; in others the entire extent of the perinæum is lacerated, and the lesion only ends at the anal sphincter; while in others, again, the sphincter and part of the rectum are included.

If, in malpositions of the fœtus, assistance is not timeously afforded—particularly in the mare—the young creature is pushed onwards by the violent uterine contractions, and should it enter the rectum the anus is dilated; while, if the expulsive efforts are continued, the sphincter and all the tissues between it and the vulva are greatly stretched and strained until they tear. Then the fœtus is finally expelled —sometimes dead, at other times alive—and there remain immense lacerations which convert the rectum and vagina into one vast opening, in which the termination of the digestive and genito-urinary organs open in common.

These ruptures, occurring immediately after birth, appear two or three times larger than they are some days afterwards, when the distended textures have contracted somewhat; the borders of the laceration are sometimes even, in other cases uneven, ragged and shreddy.

The consequences are variable, according to the extent of

The consequences are variable, according to the extent of the injury. Moderate laceration does not usually prove very prejudicial; but if severe, serious inflammation of the perinæum, extending sometimes to neighbouring tissues and organs, sets in. If the tear involves the anus and its sphincter, there will be involuntary escape of fæcal matters and flatus; and in the most formidable cases—those in which the vagina and rectum form one wide gaping cavity—the mucous membrane is irritated by the free admission of air and excreta, inflammation and suppuration ensue, fistulæ are formed, and the poor animal only too often presents a painful and repulsive spectacle.

In other instances, partial recovery takes place, and the animals do not appear to be much affected or inconvenienced. They maintain good health, rear their progeny, if born alive, and may even bring forth young again, though the wound has not cicatrized. Indeed, in severe cases union of the edges of the wound is exceptional, and in the large majority only the margin of the tear cicatrizes, and a gaping, unsightly cavity remains.

The treatment will vary, according to circumstances. If there is much hæmorrhage, styptics must be employed; if the bleeding is slight, cold may check it; but if severe, iron perchloride must be used.

The lacerated margins, if much torn, must be freed from shreds which are likely to lose, or have already lost, their vitality. They must then be brought together by sutures—either of metal, carbolized silk, or catgut. Cold-water dressings may then be applied; or styptic colloid, iodoform, boric acid, collodion, or carbolized glycerine, may be employed. The parts must be kept as clean as possible, and the animal not disturbed or allowed to lie down until union has been effected. With this object a narrow stall is to be preferred. The sutured septum should be supported from the vagina, by a tampon placed therein. This will tend to prevent the pressure of fæces tearing away the sutures in the floor of the rectum, and this result will also be greatly obviated by administering enemas frequently, and covering the mucous membrane with lard. Sloppy food should be given as diet. Fever and other unfavourable complications must be treated

according to their indications. Opiates will prove of great service; if there is much local disturbance or straining, suppositories of opium are to be recommended.

3. **Hæmatoma of the Vagina and Vulva.**—*Hæmatoma* of the vagina and vulva is sometimes observed in the mare and cow after parturition, and is due to an infiltration of blood into the connective tissue of these parts, from the almost inevitable injury they sustain during laborious parturition.

In such cases, when the fœtus is very large or in a wrong position, considerable manipulation and traction are often necessary to adjust and remove it; and this leads to bruising of the soft parts against the pelvis, and laceration and rupture of the bloodvessels and connective tissue. The bloodvessels are larger, and probably more numerous, during pregnancy than at other times; consequently, there results extravasation of blood, and considerable tumefaction of the genital canal, particularly in the vagina and vulva. Sometimes this tumefaction appears during parturition, when it may form an obstacle to birth.

The mucous membrane is raised into irregular masses, perceptible to the eye, and still more markedly to the touch. The membrane itself has a blue, violet, or black tint; the labia of the vulva are considerably swollen, and the engorgement may extend to the thighs and croup.

If there is not much extravasation, the effused blood may be absorbed in a few days; but if the hæmatoma is extensive, the blood becomes infected, gives rise to inflammation, which may run on to gangrene, and septic infection consequently ensue.

Treatment should be adopted only when the hæmatoma is large, and interferes with the passage of the fœtus, or, by pressure, with the passage of urine or fæces.

With the usual surgical precautions, the hæmatoma must be opened with the finger if possible, or the point of a knife. The clots of blood must all be squeezed out and the cavity washed out with an antiseptic lotion. This douching must be carried out daily until the wound has entirely healed. Cartwright noted that serious hæmorrhage took place when he used a knife to open the swelling. This hæmorrhage, if it occurs, must be stopped by styptics and plugging the cavity with cotton-wool or gauze.

4. **Relaxation of the Pelvic Symphysis.**—This accident, which is far from common in woman, is still more rare in animals; and there appear to be only two cases recorded, both being cows.

With regard to the cause, there is probably a natural tendency to the accident, which is increased by pregnancy, and the volume and malpresentation of the fœtus no doubt lead to its occurrence when parturition takes place. The sacro-iliac articulations may also participate in this relaxation, the symptoms of which are deformity of the pelvis and altered movement of the hind-limbs.

The animal lies almost continually, and rises with great difficulty. When up, it can scarcely move, and the hind-quarters sway from side to side, the ilium of either side rising or falling as the corresponding limb sustains or is relieved from weight. The hand, passed into the rectum, will cause pain if pressure is made on the sacro-iliac articulation. The internal angle of the ilium projects much beyond the spines of the sacrum, and when the animal walks movement can be detected between the pubic bones.

The condition is considered incurable.

5. **Rupture of the Bladder.**—Rupture of the bladder alone, during parturition, would appear to be an unusual accident, from the infrequent mention of its occurrence. That it may happen, however, is beyond dispute, and the cause of it is obvious. In the mare the act of parturition is hurried and energetic, and if it occurs while the bladder is distended with urine, the pressure of the fœtus during expulsion may rupture this viscus, and particularly if the rectum above is also full of fæces, the fœtus large, and perhaps in a wrong position.

The extravasated urine gives rise to peritonitis, and the animal will present the symptoms of that most painful inflammation. Death is inevitable.

6. **Rupture of the Intestines.**—There are some instances recorded in which rupture of the intestines—small and large—has occurred during parturition, without the uterus or other organs being involved. The accident may have been due to over-repletion of the stomach and intestines with ingesta, and the energetic action of the abdominal muscles upon these organs during the labour pains; or from the

animal throwing itself down violently, under the same circumstances.

Schaack mentions a case in which rupture was due to a loop of intestine being compressed between the fœtus and the brim of the pelvis, when the former was passing through the genital canal.

Such an accident is beyond remedy.

Invagination of the intestines—rectum and floating colon—in the mare has also occurred during parturition, due probably to severe expulsive efforts.

7. **Prolapse of the Rectum** sometimes occurs during and after parturition, and especially in mares. It is also seen sometimes in sows. It is most commonly due to the very violent expulsive efforts, particularly during protracted labour. It may occur, however, even when the parturition is not a difficult one, and Hamoir of Bois Borsu attributes this to the repletion of the rectum with fæces.

The rectum may be protruded for 1 foot up to 6 feet, and the condition of the prolapsed portion depends upon the duration of the prolapse. If exposed for any length of time, the rectum becomes congested, abraded, cold, and purple in colour. The animal soon becomes fevered, loses its appetite, becomes constipated, and strains, showing dull colicky pains. Death results in four or five days from septicæmia and peritonitis.

The prognosis is not favourable. In fifteen cases referred to by Hamoir, one recovered. The duration of the prolapse and the length of the prolapsed bowel are important factors in making a prognosis. If more than 2 feet of bowel are involved, rupture of the vessels and nerves passing to it takes place; and even if the prolopse is reduced, the bowel is paralyzed and deprived of its blood-supply, so that gangrene and septic infection set in and death quickly results. Constipation is a serious symptom.

Treatment.—In the early stages, when the prolapsed bowel is short, wash with clean water and return. Insert the hand into the rectum to ascertain if the reduction is complete. If this happens during parturition, then after reduction the hand of the assistant must be applied to the anus to prevent a recurrence of the prolapse until birth is completed.

Give rectal injections to assist the removal of fæces, and

administer laxatives and a laxative diet. Some anodyne may be administered to prevent straining.

Where the prolapsed bowel is long, Hamoir recommends resection.

8. **Rupture of the Diaphragm.**—Rupture of the diaphragm is a rare occurrence during parturition, and I can only find three cases recorded. They were probably due to the same causes as those which produce rupture of the intestines. Death resulted.

9. **Rupture of the Sacro-Sciatic Ligament.**—We can only find one case of this accident on record, so that it must be extremely rare. It is given by Naylor, and the subject was a three-year-old cart mare, which had a mal-presentation. The animal was down, and the fore-feet of the fœtus protruded beyond the vulva, but the head was not visible, it being bent back to the side of the chest; the young creature was dead. Embryotomy was resorted to, and one limb was about to be removed, when the uterus suddenly contracted with great violence, and half expelled the foal; traction then removed it. "All attempts to get the filly up were ineffectual, and an examination showed that a rupture of the sacro-sciatic ligament on the right side, with other lesions, had taken place." Stimulants and laxatives were administered, and a mustard plaster applied to the loins. "In two days she was on her legs, and tottering about the yard. Suffice it to say that she ultimately recovered, and though for two years the off-quarter was less in size than the other, she ultimately got quite well, and had two or three foals."

CHAPTER XII

PATHOLOGY OF PARTURITION

Under the head of Pathology of Parturition, it is intended to include those diseases which accompany or follow this act, and are more or less related. Some of these maladies are of great pathological interest and practical importance, and deserve the closest study. The parturient period is a very remarkable and critical one in the life of the female animal, and it becomes all the more so as the creature is submitted to the influences of domestication, and rendered more and more artificial by skilful breeding and management.

The diseases which we will consider are — (1) Metritis, metroperitonitis; (2) leucorrhœa; (3) vaginitis; (4) parturient apoplexy; (5) post-partum paraplegia; (6) parturient eclampsia; (7) parturient laminitis; (8) tetanus; (9) acetonæmia of cattle.

METRITIS, METROPERITONITIS, AND PARTURIENT FEVER, OR PUERPERAL SEPTICÆMIA.

Metritis, or inflammation of the uterus, may be limited to one or more of the internal layers of the organ (endometritis), or it may extend to its outer covering—the peritoneum (metroperitonitis). From the uterus, under these conditions, septic matters are introduced into the blood in varying proportion, setting up a toxæmia or septicæmia. In many cases the septic infection appears to be out of all proportion to the inflammation, and this is no doubt due to the nature of the infecting agent. This is frequently noted in the bitch. All the domesticated animals are liable to metritis.

The inflammation, as well as the infection, varies in

intensity from acute and subacute to chronic. It is as a rule observed only after abortion or parturition.

Causes.—The essential causal agent is bacterial. Among those bacteria found in metritis are streptococci, colon bacilli, and the organisms of putrefaction. In some cases birth is easy and natural, and yet metritis supervenes. Inflammation of the uterus, however, is favoured by wounds on the mucous membrane, by dystokia and retention of the fœtal membranes. Infection may be carried to the uterus by dirty hands, ropes, or instruments.

Retained fœtal membranes form a very frequent medium for infection. The portion of the membranes outside the vulva becomes contaminated from various sources, and the bacteria travel or grow along the membranes into the uterus, where they set up the metritis. Metritis in the mare is frequently produced by retention of a small portion of the fœtal envelopes. Dystokia favours infection, because, in the manipulations during traction, and in embryotomy, wounds or abrasions are frequently inflicted on the mucous membranes.

Embryotomy, when the fœtus is decomposing, is a dangerous operation if a wound chances to be inflicted during its performance. It is the same with removal of the fœtal envelopes. A dead fœtus which undergoes putrefaction in the uterus is a source of serious danger. This is especially so in the carnivora, because of the raw surface caused by detachment of the placenta. Want of contraction of the uterine wall is also a circumstance favouring infection. Exposure to cold and wet predisposes to the disease. It may also be due to extension of inflammation from other parts of the genital tract. Sometimes the disease appears in the form of an outbreak. An instance of this kind is related as occurring in Switzerland during 1861-1863; in a large cowshed containing about 200 head of cattle, suddenly a number died of parturient fever or metritis, though they had no difficulty in calving. For a long time afterwards no other births took place, so no more accidents of the kind occurred; but it was strongly suspected that the herdsman who attended the first sick animal cleaned it, and, in assisting the others during parturition, had conveyed the infection to them. The same cause may be in operation among ewes during the

lambing season, when, as is well known, parturition occurs in the flocks within a limited period, and not infrequently large numbers of ewes perish from parturient septicæmia ("heaving pains").

Symptoms. — Inflammation of the uterus and parturient septicæmia may ensue very soon after delivery—rarely before the second day with the cow, and seldom beyond the eighth day. With the mare and bitch, the development of these conditions may be later. In simple metritis there is tumefaction of the vulva, with heat and redness of the vagina, fever, straining, difficulty in micturition, diminution or suppression of the milk secretion, inappetence and dulness. With, and often without, treatment this condition passes off in a few days. In acute metritis the same symptoms are observable, but soon there are well-marked rigors and horripilation; if a cow, rumination is suspended; the pulse becomes small, hard and quick; the secretion of milk is stopped, and the udder diminishes in size and is flaccid; the temperature rises rapidly, and the respiration is hurried and shallow; the mouth is hot and pasty, and the visible mucous membranes injected; while the horns and ears are very warm.

The animal grinds its teeth, and betrays the existence of colicky pains by lying down and getting up, stamping, striking at the belly and turning the head towards the flanks, whisking the tail, and making more or less energetic expulsive efforts. Signs of pain or lameness in the hind-limbs become apparent. When the uterus is more inflamed, the animal does not lie down, because of the increase of pain produced by pressure on the abdomen. The smaller animals, however, maintain the recumbent position.

A very marked symptom is tumefaction of the vulva—the labia of which are separated—and the discharge therefrom of a fluid at first serous, and either transparent or having a yellow, chocolate, or reddish tinge; then it becomes gradually thicker and more abundant, and is modified according to the termination of the disease. Manual or digital exploration of the vagina, according to the size of the animal, discovers it to be very hot and sensitive, particularly towards the cervix uteri; when its lining membrane is exposed, it is observed to be swollen and reddened, and sometimes there are found

diphtheritic ulcers and croupous deposits on the inflamed surface. In some cases, when the uterus is very much swollen—and particularly in lean, flat-sided animals—the inflamed organ can be felt through the abdominal wall, and pressure on the abdomen often, but not invariably, causes pain. Rectal exploration generally discovers the uterus larger than natural, and more or less distended by gas.

Defæcation is painful, and the fæces are hard.

The mare attacked by metritis or metroperitonitis generally maintains the standing posture, with the back arched and rigid, and marked indisposition to move—only lying down on the approach of death or towards convalescence; whereas the cow persists in lying, and this is supposed to be due to paralysis of the hind-quarters, but it is more probably owing to debility or prostration induced by the pain. In the mare laminitis often sets in.

In ruminants there is generally distension of the rumen with gas; there are also acid eructations, and even regurgitations. When the temperature rises very high—and it may reach 107° to 108° F.—death is certain.

In metroperitonitis there always occurs—and sometimes very rapidly—an effusion of exudate into the abdominal cavity. When this is in great quantity, the abdomen becomes enlarged and rounded, as if the animal had been feeding freely. There is then dulness on percussion in the lower part of the abdomen, contrasting markedly with the tympanitic resonance of the upper regions; while sudden pressure by means of the open hand on one part while the other hand is placed at another point will cause a perceptible movement of the fluid.

Terminations.—The course of metritis, metroperitonitis, and parturient septicæmia, is generally very rapid, and may not occupy more than a few days—usually three or four, rarely five or six days. In some cases a chronic form may be met with, and particularly in simple metritis, following upon retention of the fœtal membranes, and sometimes upon abortion. But these exceptions are few, and the disease or diseases just named may be designated as serious when we learn that death carries off more than one-half of the number of animals attacked.

Though so serious, however, in those animals which are about to recover convalescence ensues very rapidly, especially with the cow. A few hours often suffice to bring about such a change for the better, that one could scarcely believe it unless he saw it, and it might excite a doubt as to whether metritis had really been present. In the evening the animal is left in an almost hopeless condition, and next morning it is standing, the eye limpid, the physiognomy bright and cheerful, and it caresses the offspring which previously was unheeded or repelled. The animal has not recovered, however, but it is out of danger, and with a few days' care it may be on the way to convalescence. The gradual decrease in rectal temperature is always a favourable sign.

But, as has been said, death is the most frequent termination; and this may occur in two, four, or six days from the commencement of the malady—rarely later. Then all the symptoms become aggravated. The tumefaction of the genital organs increases, and extends to the mammæ and hind-limbs; the vulva is covered with ecchymosed patches, and is cold; the vaginal discharge is ichorous and brown in colour, and emits a most fœtid odour; the temperature suddenly falls; the surface of the body is covered by a cold, glutinous perspiration—especially in the mare—and the animal expires either in a state of profound coma or in convulsions.

In such cases death may be due to the violence of the inflammation and its extension to the peritoneum, gangrene of the uterus, or to septic infection by absorption of the putrid matters in its cavity, and general poisoning therefrom.

Even when recovery appears to be progressing favourably, relapses may occur, sometimes through the breaking up and diffusion of venous thrombi, which give rise to a pyæmic process, as in the case recorded by Contamine. On the morning after an easy parturition, the afterbirth having also been expelled, the cow began to tremble very much; the udder was small and flaccid, the back arched, the appetite gone; there was anxiety, with colicky pains, constipation, and pressure in the right flank caused pain; the labia of the vulva were apart, swollen, and of a dark red colour. In three days the animal was much better, but after three weeks

there was a relapse. Petechiæ formed on the conjunctivæ, the hind-limbs became swollen, bleeding ensued from the skin and nostrils, and there was cough. The cow finally recovered.

Occasionally, during the subacute or chronic stages of metritis, metastatic formations occur in the lungs, liver, joints, and other parts; not infrequently there are caseous deposits in the uterus, which may attain such a thickness in its walls as to simulate pregnancy.

Pathological Anatomy.—In those cases in which death has taken place and an examination of the body been made, the local and essential lesions are found in the genital organs and peritoneum, and when puerperal septicæmia has been present there are indications of general infection of the body. Decomposition sets in early, the tissues are dark green and fœtid, and meteorism is most marked.

In simple endometritis such pronounced and general lesions are not found, nor is the peritoneum involved. In the more acute cases ulcers of a dirty greenish hue are generally met with in the vagina, often in the vicinity of the meatus urinarius, and about the labia of the vulva. The mucous membrane is of a dull dark red hue, and swollen in patches by diphtheritic infiltration, or covered in parts by croupous exudates. The bladder may also be implicated, though not to such a serious extent, and especially if the catheter has been employed. In the cavity of the uterus is constantly found a quantity of chocolate-coloured or greyish fluid, composed of effused blood, remains of fœtal envelopes, and the secretions of the mucous membranes—all in a more or less advanced state of decomposition, and emitting the most repulsive odour. This fluid contains quantities of epithelial and round cells, fat globules, and septic bacteria. The quantity of fluid varies considerably, according to circumstances—amounting sometimes to many gallons in the large animals.

The uterus itself is never contracted as in the normal condition, and it is often two or three times larger than it ought to be.

The walls of the organ are thickened, friable, softened, intensely red, and infiltrated with sanguinolent serosity,

inflammatory products, and pus corpuscles. The mucous membrane is thickened, of a dirty brown or dark green tint, livid, softened, ecchymosed in places, and covered here and there with diphtheritic or fibrinous exudates and blood-clots, the latter being chiefly found—in the cow—at the base of the cotyledons, which are, with the exudates and clots, in process of putrefaction, and are grey, pulpy, and almost detached. Sometimes portions of decomposed fœtal membranes yet remain attached to the cotyledons; and there are here and there gangrenous eschars, in the form of green or greyish spongy masses, which are in process of softening and dissolution. In all these alterations—which are usually very notable in the cornu that contained the fœtus—there are the characteristic features of *endometritis septica*.

It is seldom indeed that the puerperal or septic inflammation is limited to the mucous membrane. Nearly always it extends to the muscular coat (*metritis phlegmonosa*), which becomes the seat of acute inflammatory œdema, in which the intermuscular tissue becomes tumid, and its interstices filled with fluid, small cells, and a gelatinous, semi-solid material. The muscular tissue is swollen and softened, and a dark fluid flows from it.

The subperitoneal connective tissue of the uterus may suffer in like manner, and undergo necrotic softening and putrefaction; while the serous membrane itself may become inflamed (*metroperitonitis*).

When this takes place, the abdominal cavity contains a quantity of reddish, turbid, sanious serosity, in which are flakes of lymph. The lining membrane of this cavity, and especially that covering the uterus, is highly inflamed, and its surface is covered with pseudo-membranous layers of fibrin; while adhesion may have taken place between the different organs it covers. In some cases the inflammation of the peritoneum is not so diffuse, and is more or less limited to the uterus and organs immediately adjacent.

In other cases, again, the phlegmonous inflammation extends to the pelvic connective tissue (*parametritis*), and then there is diffuse acute œdema, infiltration with pus, or even abscesses.

Indeed, in the uterine connective tissue there may be, in different parts, active cell proliferation and abscesses; and if the animal chances to live beyond a certain period, these terminate in caseous inspissation, or even perforation into the abdominal cavity.

A very important pathological lesion, and one which is not infrequently noted in parametritis, is thrombosis of the veins and lymphatics. Thrombosis of the uterine veins has been observed in animals — solid, white, or yellowish thrombi adhering to the internal surface of the vessels, and extending towards the larger venous trunks—even as far as the posterior vena cava. Sometimes the breaking-up of these thrombi causes relapse, and embolic pyæmia of the lungs or neighbouring organs. Bruising of the soft parts during difficult parturition may give rise to thrombosis of the veins, and sepsis extending to the thrombus may be followed by a secondary pyæmia. This may explain the occurrence of abscesses appearing at the joints, and inflammation of the feet supervening on parturition. Thrombosis of the lymphatics has rarely been observed in animals; it is noticed within the inflamed spot. "The coagulated lymph either uniformly fills the vessel or gives the appearance of a string of beads. Sometimes, also, single larger dilatations of lymphatic vessels are seen. The thrombosis may be due to the direct influence of the infecting matter, but more frequently it is caused by the inflammation of the connective tissue around the vessel. The products, also, of the inflammation of this tissue have a tendency to coagulate, and the contents of the vessels participate in the process." Sometimes the lymphatics are filled with pus (*purulent lymphangitis*), and the neighbouring glands are swollen and softened. This thrombosis of the lymphatics has been considered a favourable circumstance, since the occluded vessels are prevented from conveying the infecting materials, the inflammatory process being at least delayed at the nearest group of lymphatic glands. The lymphangitis is therefore considered an accidental change, which usually remains limited to the diseased part, and may disappear; and it has been remarked that it rarely extends farther towards the thoracic duct, unless there are other very considerable changes.

Sometimes the thrombi in the vessels of the uterus soften; so that, in cutting into the walls of the organ, they appear like small abscesses, varying in size from a pea to that of a nut. They can only be distinguished from abscesses by their smooth walls, since the afferent and efferent vessels cannot always be found.

In intense parametritis, with extensive infiltration of the subserous connective tissue, other organs may be involved, and especially those which are directly connected by means of this tissue—such as the ovaries. The peritonitis may extend through the diaphragm to the pleuræ, or the inflammation in both membranes may be due to ichorrhæmia.

In those cases in which thrombi in the bloodvessels have become detached and broken up, the fragments may be carried in the circulation, and give rise to embolism and hæmorrhagic infarcts, or to metastatic abscesses in such parenchymatous organs as the lungs, liver, spleen, kidneys, etc.

In the most rapidly fatal cases, in which death is due to septic parametritis, there is no time for fibrinous exudation, and there are appearances not unlike those observed in splenic fever. The blood is dark-coloured and non-coagulable, ecchymoses are found in various organs and tissues, and there is a marked tendency to rapid putrefaction. The elementary structures of organs show the commencement of an acute febrile process — the fine granular infiltration or "cloudy swelling," fatty degeneration, or even disintegration of cells.

Prognosis. — The prognosis of metritis is frequently unfavourable, as the veterinary surgeon is only too often not called in until too late. When infection is but slight, or when the local inflammation is not very severe, then careful treatment may restore the patient to health. Vomiting is a very serious symptom in the dog, and the animal may die in twelve to twenty-four hours.

Prophylaxis.—This must be treated as a contagious disease. If a case of metritis appears where there are pregnant animals, or animals which have quite recently brought forth, these should be immediately removed and isolated. The soiled ground and the discharges from an infected animal should be carefully disinfected. In dealing with dystokia, surgical cleanliness

must be observed. Care should be taken not to wound the mucous membranes of the uterus or genital passage. No attendant upon a case of metritis should be allowed to assist in delivery of another animal. After parturition, if there is any indication of a wound in the uterus, the latter must be washed out with boiled water or a weak antiseptic lotion, so as to clear away any débris or infective agents.

Treatment.—If the fœtal membranes are retained, they must be searched for and removed. Then the uterus must be irrigated with a lukewarm, mild antiseptic or sterilized lotion, such as normal saline solution, oxygenated water, potassium permanganate (1 to 1,000), carbolic acid or creolin ($\frac{1}{2}$ per cent.). For this purpose a piece of thick india-rubber tubing about 4 or 5 feet long, with a filler attached to one end, the other end being inserted into the uterus, is a very convenient instrument. The fluid passes into the uterus by gravitation. A Higginson's syringe with a female catheter attached may be employed in the bitch. One or two gallons in the mare or cow, a few ounces of the solution in the bitch, are introduced at a time, and then allowed to escape, or after a few minutes removed by siphoning, when no attempt is made by straining, on the part of the animal, to get rid of it. The bitch may be raised on her hind-limbs to effect this. This irrigation should be repeated several times, until the fluid comes out quite clear. With potassium permanganate, the irrigation should be continued until the colour of the fluid ejected is unchanged. Williams recommends the use of iodoform afterwards. Half an ounce of this material is introduced in a gelatine capsule into the uterus of the mare or cow, the capsule broken, and the iodoform scattered through the cavity of the uterus. Antiseptic pessaries are also used with success. The irrigations should be carried out once daily. When the fluids cannot be removed from the uterus, injections of fluids should be abandoned as they only distend and weaken the walls of the uterus already damaged by disease. In these cases antiseptic pessaries alone should be introduced. In the treatment of endometritis in cows Nielsen recommends the injection of small quantities of weak solution of iodine as described under the heading of sterility. Where there is a rupture in the uterus, injections must not be employed, but

the interior of the uterus mopped out with a sponge or piece of absorbent wool soaked in an antiseptic solution.

Externally, hot fomentations, poultices, or counter-irritants should be applied to the abdomen and loins when there is any marked evidence of pain. If there is a tendency to constipation, a purgative must be administered. The strength of the patient must be maintained by stimulants, such as strychnine, caffein, or ether hypodermically, or diffusible stimulants, such as alcohol and nitrous ether, by the mouth. Hypodermic injections of normal saline solution have also been recommended for the same purpose. In addition, internal antiseptics should be given to counteract the bacterial invasion, such as sulphite of soda or quinine. Ergot or its derivatives—*e.g.*, ergotin or hydrastis—are recommended to induce contraction of the uterus and the ejection of the fluids, and exudates within the uterus in order to prevent their absorption. In recent years pituitrin has been recommended for this purpose.

The patient must be kept warm and comfortable. The food must be laxative and nourishing.

In the mare, laminitis as it arises must be dealt with according to the indications.

In the bitch, if it is impossible to irrigate the uterus, it may be necessary to perform hysterectomy to save the life of the patient. When recovery is taking place, tonics and good food must be allowed. In the treatment of metritis in the bitch and cat Migley of Paris has claimed good results from uterine insufflations of iodine vapour, and he attributes the success of this method to the vapour reaching the extremities of the uterine horns, while injections of antiseptic fluids did not do so. The vapour is liberated by heating metallic iodine (two or three centigrammes per kilo body weight) in a test tube and this is attached by an indiarubber tube to a cannula which is passed into the uterus. The iodine vapour is blown into the uterus by means of a bellows or air pump connected with the test-tube. This treatment is repeated every two days until the cure is complete. The first insufflation should be preceded by an abundant irrigation of boiled water

PYOMETRA—CHRONIC METRITIS.

Chronic metritis frequently follows as a sequel to acute metritis. Sometimes it appears without that history. It has been observed chiefly in the mare, cow, bitch, and cat. The disease sometimes occurs in animals which have not been bred from at all; in fact, in the bitch it is frequently the case that the affected animal has either not been bred from for a number of years previously or has never been pregnant.

The inflammation is of a suppurative nature, and if the os uteri closes the pus accumulates within the uterine cavity.

Symptoms.—If the disease follows the acute form, the more acute symptoms gradually diminish, and the animal does not exhibit much suffering. In all cases the patient remains in indifferent health, and the secretion of milk is either very scanty or altogether disappears. There is a constant or intermittent discharge from the vagina, which soils the tail and thighs of the animal. This discharge is either of a white, glairy character, greyish and grumous, resembling clotted milk, or red or brownish in colour. It is frequently fœtid, particularly in the cow in which the fœtal membranes have been retained. Sometimes false membranes or croupous exudates which have formed in the uterus are cast off with the vaginal discharge. In the bitch the uterine discharge has a mawkish odour and on bacteriological examination has been found to contain bacilli of the colon type which may be responsible for the trouble.

When the cervix uteri contracts, the muco-purulent secretions are retained for some time, and the discharge from the vulva ceases. But when the organ becomes distended, it contracts, or it is pressed upon when the animal lies down or during micturition or defecation, then the os is forced partially open, and the accumulated fluid escapes in great abundance. Affected mares, for example, have been known, every forty days, every month, or at shorter intervals, to expel 14, 16, and even as much as 20 pints of pus after exhibiting symptoms of colic, followed by more or less marked expulsive efforts.

The animal soon loses condition; the appetite is irregular

the skin clings to the bones; and though debility is present, œstrus may occur far more frequently than in health, yet fecundation is not possible. Marasmus sets in with febrile attacks at intervals; and though recovery is still possible, by skilful treatment and long-continued nursing, yet death is only too often the sequel.

In the smaller animals, distension of the abdomen becomes very marked, and resembles ascites. From the latter it may be distinguished because the distension is more lateral, the swelling can be defined by manipulation, and no fluctuation can be made out on palpation as in ascites.

The diagnosis is made by the vaginal discharge and by rectal examination in the large animals and abdominal manipulation in the bitch and cat.

The editor has observed a number of cases of sudden death in the bitch where pyometra was the only lesion found on post-mortem examination.

Treatment.—When the os is closed, it must be dilated by manipulation. This operation may occupy several hours. The pus present in the uterus must be siphoned off, and the uterus irrigated daily with any of the antiseptic injections recommended for acute metritis, such as potassium permanganate, carbolic acid, corrosive sublimate (1 to 3,000). The os must be kept open by plugging with gauze. An antiseptic suppository should be introduced into the uterus. Williams recommends iodoform, or a solution containing carbolic acid 1 drachm, tannin 1 ounce, glycerine 4 ounces, and tepid water 1 pint, for the mare. Hobday has used vaginal injections of hydrastis canadensis with success, giving the same drug also by the mouth.

Internally, tonics and antiseptics must be administered, such as nux vomica, iron and copper sulphate, potassium iodide.

Good results have recently been claimed in the treatment of the condition in the bitch by the administration of pituitrin. Hobday recommends doses of 1 to 2 c.c. given hypodermically at intervals of three days until the vaginal discharge has ceased.

In the bitch, because of the difficulty of giving intra-uterine injections, the best treatment consists of total extirpation of the uterus (hysterectomy).

LEUCORRHŒA.

Leucorrhœa is a chronic vaginal discharge. It is usually of a white, glutinous, and odourless character; or it may be purulent, muco-purulent, or even chocolate-coloured and sour-smelling, or sanious at times. It is mainly composed of mucus, but it contains also, and sometimes in abundance, catarrhal cells, pus corpuscles, and various organisms, such as micrococci. It usually results from an inflammation of the mucous membrane of the vagina, and even the uterus, and may occur during pregnancy or after parturition. Sometimes the discharge is intermittent, and appears only when the animal is lying down, or in movement, or during micturition. It is more frequently observed in the cow than the mare, and is not common in the bitch. In many cases the appetite is unimpaired, and the animal is in no way inconvenienced; in other instances, with the increase of the discharge and the duration of the disease, there is loss of condition and appetite, the yield of milk is less, and becomes even viscid. Signs of œstrum are more frequently present, but fecundation does not take place so readily as in health if the os and uterus are affected; if it does occur, the chances are that the full period of pregnancy will not be reached.

When the discharge is chiefly from the cervix uteri, it is more transparent and watery-looking than when it comes from the vagina or interior of the uterus, and the os is usually more or less dilated when these parts are involved, while the uterus itself is not so firmly contracted as when in a sound condition.

The mucous membrane of the genital canal is pale, relaxed, and insensible; in other cases it may be roughened by granulation, and sometimes it is tumefied and red. Vaginal catarrh of the bitch is often associated with, or dependent on, the presence of papillomata or epitheliomata.

In rare instances the tissues forming the canal become indurated, and even adhesions between the sides of the vagina have been noted.

Treatment.—Leucorrhœa is only a symptom of disease, and an attempt must be made to ascertain the cause. If due to

tumours, their malignant or benign nature should be ascertained. With malignant tumours, attempts at removal are not likely to be followed by recovery.

In the other cases, due to inflammation of the vagina and uterus, the treatment should consist in attention to cleanliness and antiseptic astringent injections, such as solution of sulphate of zinc, or alum (1 per cent.), permanganate of potash (1 in 1,000), tannic acid, etc., or pessaries containing similar agents.

When the condition has been in existence for a long time, it is generally very obstinate. The uterus or vagina, or both, if affected, should be thoroughly washed out twice daily with warm water, which ought to be injected until it flows out quite clear. Any of the above astringent lotions should then be injected, such as alum, or $2\frac{1}{2}$ per cent. carbolic lotion, or silver nitrate (1 to 50 or 100).

Tonics should be freely administered and good food allowed.

VAGINITIS.

Inflammation of the vagina may exist independently, but it is generally an accompaniment of inflammation of the uterus, which, being the more serious evil, masks this malady. When occurring after parturition, it is generally due to protracted and laborious delivery, which necessitates manipulatory efforts, the use of instruments, etc.; the passage of a very voluminous fœtus, the pressure of a pessary, or any other cause that may lead to irritation, bruising, or wounding, of the mucous membrane. All these factors facilitate the admission of pathogenic organisms. The disease is all the more likely to occur if the instruments used at parturition or the hands of the operator are dirty, or if the fœtus is dead and decomposing. It sometimes also follows retention of the fœtal membranes. The inflammation may lead to suppuration, ulceration, or gangrene, more or less extensive.

Symptoms.—The labia of the vulva and the lining membrane of the vagina are more or less swollen, the latter being of a deep or bright red, brown, or livid hue; there may also be

patches of congestion and ecchymoses, with wounds or abrasions, and in rare cases phlyctenæ may be observed on the surface of the membrane. The condition of the vagina may be ascertained by examination with a speculum. The temperature of the canal is greatly increased, while its walls are dry, and often adhesive. Micturition is generally painful and difficult, constipation is often present, and there is sometimes much itching in the region of the vulva, which is indicated by the continued attempts the animal makes to rub the part. If the inflammation is severe and extensive, fever will be present.

When the inflammation has existed for one or two days, a vaginal discharge appears, which is at first a serous limpid fluid, sometimes streaked with blood; then it gradually becomes thicker and sero- or muco-purulent, soiling the tail and thighs and hocks, and sometimes becoming so acrid as to cause removal of the hair and excoriation of the skin.

Prognosis.—Simple vaginitis of itself is not as a rule very serious. The inflammation often subsides in the course of a few days, or rapidly yields to treatment. If unattended to, it may become chronic, and, although it may not affect the health of the animal much, it may induce sterility. In some instances it assumes a troublesome, if not a grave, character. When gangrene ensues, there may be also infective inflammation in the surrounding parts, and large portions of the membrane, or even the skin of the labia, may slough, while the discharge is sanious and fœtid.

A diphtheritic or croupous form of vaginitis was noted by Baumeister in the cow, and is not at all infrequent. It is contagious. This disease appears a few days after calving. The vaginal discharge is fœtid, purulent, or sanguinolent. The lips of the vulva are thickened, swollen, and very tender. On exploration, the vaginal walls are found covered with yellowish, false membranes, with warty vegetations on the surface. The whole of the vaginal mucous membrane may be invaded, and the disease has a tendency to spread to the uterus and with great rapidity. These false membranes are very adherent. The animal strains frequently, especially when recumbent, and may even cause inversion of the vagina. The disease is very grave, causes rapid wasting,

loss of appetite, and continuous fever. Death may supervene in a few days.

The cause is not well determined, but probably is some organism, such as the bacillus of necrosis.

Treatment of Vaginitis.—The chief principle in the treatment is the removal of the morbid products from the vagina. This is carried out by irrigating that canal first with lukewarm water until the latter comes out quite clear, and then injecting some antiseptic lotion, such as chinosol (1 to 1,000 of water), boric acid (4 per cent.), potassium permanganate (1 to 1,000), oxygenated water, carbolic acid, lysol, cresyl (1 to 2 per cent.). Astringents such as alum (2 per cent.) and zinc sulphate (1 per cent.) are most serviceable in chronic cases. These injections should be given once or twice a day. If there is much straining, a little anodyne may be added to the solutions to be injected. In severe cases the internal administration of such agents as quinine and potassium iodide are indicated, with general attention to diet and cleanliness.

PARTURIENT OR PUERPERAL APOPLEXY.

This disease is also designated milk fever, vitulary fever, calving fever, parturient paresis, dropping after calving, parturient intoxication, parturient toxæmia.

Whatever term is applied to the disease, it must be remembered that it is not accompanied by fever, and that it is not a true apoplexy, in that there is no hæmorrhage in connection with the brain or spinal cord, save in exceptional cases. This affection has no analogy to child-bed fever of the human subject. It is a very serious and acute disease of cows, appearing at or soon after parturition, in which the invasion is sudden and the course rapid, and characterized by loss of consciousness and paralysis, seldom by convulsions.

The malady appears to have been known from an early period, but the first exact description of the symptoms we can find is that given by Skellett in his "Practical Treatise on the Parturition of the Cow" (1807), who names it "milk fever or dropping after calving." In the following year it is alluded to by Jörg, who evidently knew Skellett's work, as the latter's

plates are copied. Some years after this period the disease began to attract much attention, as with improvement in the breeding of cattle it gradually became more prevalent, until now the literature of the subject is very extensive.

Symptoms.—The disease sets in suddenly after calving, and often without any premonitory symptoms. It may attack the cow so early as twelve or twenty hours after parturition, but it is most frequent on the second or third day, and generally follows a rapid and easy birth. It has, though rarely, manifested itself during parturition, and also before that act, but never before the appearance of milk. It is seldom that it appears after the third day, though it has been seen as late as the tenth or the fourteenth day, and exceptionally in the fourth week. Occasionally veterinarians have recorded cases which offered all the symptoms of the disease six or seven weeks after calving, and responded to the usual treatment of milk fever. Exceptionally it has been noted after abortion in the very late stages of pregnancy. The severity of the attack is usually in direct proportion to the rapidity of its development after calving. The longer the interval after parturition, the milder the attack. In some instances, before the symptoms commence, the lacteal secretion is either diminished or suspended. Generally the first indications are the cow hanging back in the stall or the head drooping; there is uneasiness, whisking of the tail, striking at the belly with the hind-feet; the appetite is suddenly lost and rumination ceases; and the animal becomes indifferent to its calf. There is often a shivering fit, but this is not followed by an increase of temperature. In a few cases the cow presses its head to the wall, or leans against the stall-post, sometimes it bellows; its mouth is hot, the eyes are reddened, and the eyelids wink, and it half unconsciously treads with the hind-feet. The respirations become hurried and plaintive, though the pulse may be normal. The animal becomes unsteady and staggering in its gait, can no longer stand, and it either lies down or falls on the floor of the stall. There it may remain tranquil, merely moaning or bellowing, or striking with its feet at the belly as if affected with colic, and making convulsive movements. The ears and horns may be warmer than normal, and, in addition to the redness of the eyes, tears may flow down the cheeks.

All these changes generally become developed in a few hours; so that an animal which was left in apparent health only a short time before is found lying, cannot get up, and is in a soporific condition. This is the stage of the malady at which the veterinary surgeon is usually sent for. Then he finds the cow lying tranquilly on its side, fully extended (in which case tympany soon results), or, which is far more frequent, resting on the sternum, and the head turned round towards the shoulder or flank. This position of the head is supposed to be due to contraction or tonic spasm of the cervical muscles of one side of the neck. It is sometimes observed at the commencement of the attack, even while the

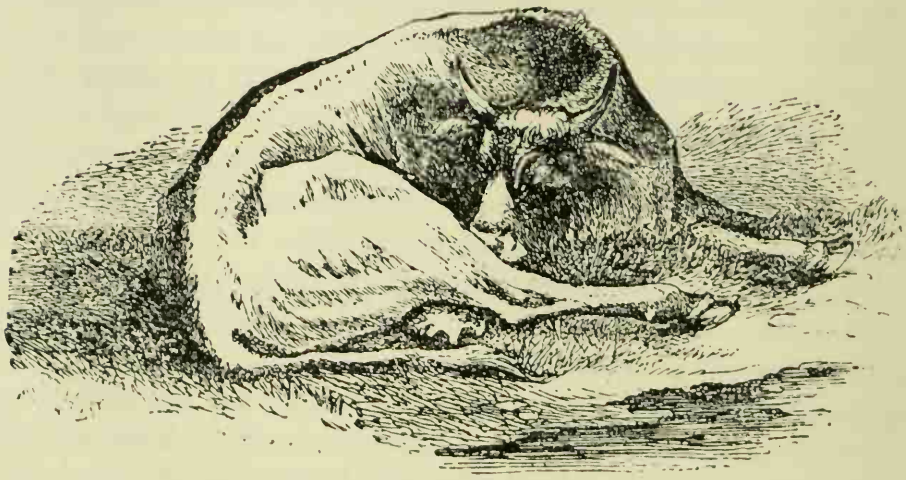

FIG. 165.—PARTURIENT APOPLEXY: COW.

animal is standing. The neck is so rigidly bent that force cannot extend it. In other instances the head is extended out in front on the ground. From time to time the cow may attempt to rise, but it cannot as a rule do so; the knees may be flexed, but the hind-parts seem to be fixed to the ground. If assistance be afforded, it cannot avail itself of it; or if it chances to be raised, it falls again as soon as let alone. It appears to be insensible to blows or pain of any kind; and if the head is lifted and let go, it drops an inert mass or is again pressed round against the shoulder. The teeth are ground at intervals, and the stupor or coma becomes more marked.

The animal pays no heed to surrounding objects; the eyes

are half closed, and are dull and lustreless; the hair is erect and dry.

The pulse does not vary much from the normal in the early stages; it is generally soft and full and more frequent, and may number 50, 60, or 70 beats per minute. When coma is well advanced, it becomes small and quick, numbering 100 to 120, and at last is irregular and almost imperceptible.

In marked coma and paralysis the respirations are often slow and deep—from 5 to 8 per minute—sighing or stertorous, indicating paralysis of the soft palate. When the respirations are markedly increased, up to 80 or 90 per minute, the disease has probably become complicated with pneumonia, due to the passage of food and other bodies from the pharynx down the trachea into the bronchial tubes—a not uncommon accident of the disease. In very acute cases the cow sometimes breathes through its mouth, and puffs out the cheeks. A moan may accompany each expiration.

The internal temperature is quite or nearly normal. In deep coma it has been found as low as 35° C. (95° F.), and even 32° C. (90° F.), and rises again when there is an improvement. It is possible that, in the cases in which very low temperatures were noted, the anal sphincter has been relaxed, so that the air passing into the rectum would make it cooler than normal. The extremities—feet, horns, and ears—are generally icy cold, and the surface heat of the trunk is irregularly distributed.

The mucous membrane of the mouth is pale, and saliva accumulates about or flows continually from it. Food and water are refused, and, indeed, at an early stage there appears to be paralysis of the pharynx and œsophagus; and if care is not taken, the solids or fluids attempted to be administered may find their way into the air-passages, and, if they do not quickly produce asphyxia, they will probably give rise to pneumonia. When fluids are administered, they pass down the œsophagus with a gurgling sound. The functions of the rumen and digestive system are more or less suspended, and the peristaltic movements of the intestines decreased. Hence tympany, eructations, and constipation, result. Tympany is especially marked if the cow lies on her side. The eructations may carry food and fluid from the rumen into the pharynx, and even into the nostrils, and they may pass thence into the

trachea. Pneumonia may occasionally be set up by this cause alone, without attempts having been made to administer food or medicine. Constipation is also a marked feature of this paralyzed condition, and little or no defæcation occurs.

Micturition is, as a rule, suspended from the commencement; consequently urine accumulates in the bladder, and it usually contains sugar—as first shown by Nocard—and albumin.

The secretion of milk may be diminished or suspended, and sometimes very suddenly, even before the voluntary muscles are paralyzed; in other instances it may be uninterrupted.

The above are the common symptoms of milk fever. In a few cases eclamptic symptoms are shown. The cow for intervals of half or three-quarters of an hour becomes very restless and excited, frequently bellows, grinds the teeth and slobbers at the mouth, rolls the eyes in the sockets, and becomes affected with spasmodic contractions of various groups of muscles. It throws its head about violently from side to side, or bends it rigidly backwards, extends the limbs convulsively, while at the same time it appears to be unconscious. After varying intervals she again becomes quiet.

Duration, Termination, and Complications.—The duration of the disease is very brief. It may last only a few hours, or be prolonged for two or three days. Exceptionally it extends to five or six days. The terminations are death or recovery.

When the animal is about to recover, it appears to rouse up suddenly from the stupor into which it was plunged; the tongue is moved about, the head is raised, attempts are made to get up, it elevates the fore part of the body, and after some struggles finally gets on its hind-legs and stands. The first favourable indications are elevation of temperature, if it is subnormal, and the resumption of the intestinal peristalsis. The animal's physiognomy becomes natural; it drinks, seeks food, and is not long in commencing to ruminate; urine and fæces are passed; and recovery sets in so promptly, and goes on so quickly, that within a few hours an animal previously appearing to be dying has completely recovered without being convalescent.

When death is about to take place, the more serious

symptoms are still more marked. The coma becomes more and more complete. The nose rests on the ground, as if the animal could no longer support the head, and at times sways from side to side. The decubitus, instead of being sternal, becomes lateral, and the body is stretched out at full length. The eye is glassy, and there is no movement of the eyelids when the cornea is touched; the body and mouth are colder; the tympanites increases; the pulse becomes small, irregular, intermittent, and very quick, until at last it is imperceptible; the breathing is puffing, slower, and more stertorous, and the animal dies without a struggle or in the midst of slight convulsions.

One of the chief complications of this disease is pneumonia. This complication is due to the passage of foreign matters—either food or medicine—into the air-passages during the period when the animal cannot swallow, or when it is comatose, and eructations occur. This is sometimes a cause of death when the cow has recovered from the parturient malady. Indeed, the animal may perish from suffocation alone when the quantity of matter that passes through the larynx is considerable. And not infrequently, when the cow has lingered for a few days and is then killed, the existence of pneumonia from this cause will be discovered on making an examination of the body. Hence, in the modern treatment of milk fever, drenching must be carefully avoided. Sometimes the animal appears to be almost recovered from the attack of parturient apoplexy, when symptoms of lung congestion or inflammation are suddenly developed, and death soon occurs.

Another complication is paralysis. This is not evident until the animal recovers consciousness, and begins to look bright and anxious for food, when it cannot be made to rise. The paralysis may affect various parts, most commonly one or both hind-limbs. Gangrene of certain parts—feet and teats—has occasionally been noted. The cow will have recovered from an attack of milk fever from ten to fifteen days, when a fœtid fluid is found exuding between the claws and around the coronets of the hind-feet; soon a line of demarcation forms about the middle of the shanks, and this is quickly followed by complete sphacelus of the extremities.

Swellings in the region of the thigh and hock have also been noted. Probably these conditions are due to damage during struggling and slipping that takes place before the animal becomes unconscious and immovable, or to insufficient bedding and prolonged lying on one side.

A few cases have been noted in which the cow completely recovers from an attack, and again becomes affected on one or two occasions after an interval of a few hours or days.

Prognosis.—Since the introduction of injections of the udder, the prognosis of the disease is exceedingly favourable, There is now upwards of 90 to 95 per cent. of recoveries. With the older forms of treatment 30 to 50 per cent. of the cows died. The prognosis is always more favourable when the patient receives prompt attention, and has not had medicinal agents administered to it in the form of drenches. The earlier the disease appears after parturition, the more serious is the case. Unfavourable symptoms are—Marked coma, general and long-continued loss of heat, great distension of the rumen, violent convulsions, deep mucous râles in the trachea and bronchi, lustreless eyes, puffed breathing by the mouth, pendulous lower jaw, and the rectum remaining empty when it has been evacuated. Favourable indications are—Maintenance of the normal temperature in the body and limbs, natural tint of the mucous membranes, spontaneous expulsion of urine and fæces, and a return to consciousness. If an animal remains down for several days, four or six, the chances of recovery are very poor.

Causes.—The actual exciting cause of the disease is as yet obscure, but the conditions under which the disease appears are well known. This is essentially a disease of domestication, and appears only in cows at or after parturition, rarely before. With the perfecting of cows for the production of milk, this disease has become vastly more prevalent. Certain breeds and individuals are predisposed to milk fever. The cows most liable to be attacked are those in which the secretion of milk is abundant and the milk rich in fat—"deep milkers"—and especially when they are in good condition. It is therefore a disease most peculiar to the best breeds of milch cows, and the malady has extended with the extension of these breeds. In countries or districts where bovines are reared

more for their flesh than their milk, parturient apoplexy is rather uncommon—*e.g.*, in Hereford or Aberdeen Angus breeds. In North Holland the disease appears to have been completely unknown eighty years ago, but when attempts were made to improve the milking qualities of the cows by importing numbers from South Holland—where they are "deep milkers," and where the disease is very frequent—then it showed itself and became prevalent.

Plethora, no doubt, exercises a great influence in the production of the disease, for it is chiefly among well-fed cows—particularly those kept for milk in the vicinity of large towns, which seldom or never leave their shed, and are abundantly nourished immediately before calving—that parturient apoplexy prevails most seriously and extensively. Even among cows at pasture, when the herbage is luxuriant, the disease is far from infrequent. It is true it may attack milch cows in moderate, or even in comparatively low, condition; but frequently then these are cows which, having been scantily fed during the long winter, are abundantly supplied with food in the spring; or they are cows which, purchased in low condition, receive a large supply of food from their new owner. It has also been remarked that a uniform, and even abundant, diet is less dangerous than an abrupt change from scarcity to generous allowance.

The risk of contracting the disease is all the greater if the secretion of milk has been suspended for some time before calving, the cows meanwhile receiving the same amount of food.

Permanent confinement in the cowshed also increases the tendency to put on condition, and to milk fever. Thus it is that, while the disease is prevalent in the cowsheds near towns, or in those from which the cattle are seldom driven out to graze or for exercise, it is as a rule uncommon in hilly pastures.

The development of lactation has also a powerful influence. The cow is subject to the disease during her best milking years. Parturient apoplexy seldom appears before the third calf, the time at which lactation is reaching to near the height of its development. One attack of the disease predisposes to another.

The following are statistics of 931 cases furnished by Danish veterinarians, showing the disease to be most common between the sixth and tenth years :

Age ...	2 to 3	4	5	6	7	8	9	10	11	12	over 12
Number of Cases ...	7	17	55	146	149	184	95	102	41	64	71

The season of the year or temperature does not appear to have a definite influence, save with regard to its effects upon the quantity and quality of available foodstuff, and in that way upon the condition of the cattle.

In the great majority of cases, parturient apoplexy follows an easy and rapid expulsion of the fœtus without assistance, and ejection of the fœtal membranes at the normal time. The disease very rarely appears after a difficult or protracted delivery. Before the expulsion of the fœtal membranes the disease is uncommon. In very few cases the attack has commenced during parturition, and in still fewer before birth.

Pathological Anatomy.—The lesions found on post-mortem examination of an animal which has been killed or allowed to die are very limited, and often indistinct. Indeed, it may be affirmed that no changes will be demonstrated which can be attributed to milk fever when there are no complications. The generative organs are usually little changed ; the uterus may be congested—which it always is immediately after parturition—or it may even be paler than usual, but it is generally firmly contracted. The digestive organs are also usually normal, or their bloodvessels are much distended. The rumen is distended with gas in many cases, and the omasum is often filled with hard, dry food between the leaves, while the intestines contain somewhat hardened fæces. The liver, according to some authors, is paler than normal, and may even show capillary hæmorrhages and fatty degeneration (Ehrhardt). The gall-bladder is sometimes much distended. The lungs are normal ; sometimes they show slight emphysema. Any lesions presented by these organs, such as pulmonary congestion or pneumonia, are usually due to food-stuffs or drenches passing down the trachea.

In the central nervous system frequently no pathological

lesions of note have been found. The lesions are inconstant, and vary from venous congestion to œdema, anæmia, and exudation. Violet observed congestion of the pia mater with very dark blood, congestion of the vessels in the brain tissue, and a long clot in the great vena Galeni. The spinal cord appeared to be healthy. Bragard and others have constantly found injection of the brain and its meninges. Saake and Festal have also witnessed congestion of the vessels of the encephalon, subarachnoidal effusion, extravasation, and blood-clots on the surface of the cerebrum and cerebellum. Others have seen serous effusion in the lateral ventricles and traces of spinal meningitis; while Fabry has observed blood-clots at the base of the brain, with serum in the cavity of the arachnoid.

In one instance, Schaack met with a clot covering the left side of the medulla oblongata, and serous effusions into the lateral ventricles; and in another instance an inflammatory exudate on the right side of the cerebellum. Harms claims to have found in many cases air in the cerebral bloodvessels; and Noquet and others have reported alterations in the spinal cord, which was reddened, congested, more rarely covered with exudate, chiefly in its lumbar portion, and sometimes the sciatic plexus of nerves has been involved.

Nature.—With regard to the determining causes of the disease there has been great diversity of opinion, and even now the most eminent veterinary authorities are not at all agreed as to its pathology.

The treatment of the udder, and the marvellous results which have been achieved, point to some condition in connection with that organ which sets up the disease. This condition may be of the nature of an auto-intoxication or toxæmia. It is possible, however, that the injection of the udder may merely act mechanically in checking the rapid formation of milk which appears to be a prime factor in the causation of this disease.

The older theories as to the essence of the disorder may be classified under five heads: (1) Hyperæmia of the nerve centres; (2) anæmia of the nerve centres; (3) derangement or paralysis of the nerve centres; (4) alterations in the con-

stituents of the blood; (5) the presence of something abnormal in the blood that leads to the development of the symptoms and lesions observed.

1. **Hyperæmia of the Nerve Centres.**—Since 1847 the opinion has been held that the disease is due to plethora, and consequent congestion or apoplexy of the nerve centres. According to Sanson, the parturient apoplexy is the consequence of a sudden disturbance in the physiological condition of the uterus after parturition, consisting in the abrupt removal of blood which congested the organ at that time—as during gestation a large portion of that fluid is diverted towards the pelvic region, where the uterus is lodged. After parturition the mucous membrane and cotyledons of the organ have lost their function, and the enormous quantity of blood they contained is suddenly thrown into the circulation, surcharges the neighbouring vessels beyond measure, and produces collapse. In proof of this, at the autopsies he made, Sanson affirms that the mucous membrane and cotyledons were always found bloodless and of a pale yellow colour.

Violet maintains that this cerebral hyperæmia is the essential cause of milk fever, and is due to the exceptional rapidity of parturition. An easy birth, according to this author, suddenly diminishes the intra-abdominal pressure, which affects the heart so much during pregnancy, and to which it and no other organs have to accommodate themselves. Birth taking place rapidly, the heart continues to act in a fashion to which the blood-vessels, particularly the capillaries, are not accustomed, so that they gradually become distended, and finally congested; hence ruptures and hæmorrhages may occur, and a fatal termination. That it occurs only in the cow he explains by special idiosyncrasy.

The theory advanced by Félizet, Günther, and others, that this congestion was the moral result of removing the calf from the cow immediately after parturition, is quite untenable, because, were this theory correct, the disease would be more likely to occur after the first calving. The disease also appears when the calf is left with the cow.

Some have considered the disease to be essentially an encephalitis, myelitis, meningo-cephalitis, or a cerebral or medullary apoplexy, according to the character or seat of the lesions found after death.

But these opinions are opposed by the fact that many of the lesions on which they are based are seldom observed, and that the recovery of affected cows is often very rapid.

2. **Anæmia of the Nerve Centres.**—Many years ago Haubner came to the conclusion that puerperal collapse was due to cerebral anæmia resulting from an *ex vacuo* hyperæmia of the abdominal organs, as cows of a certain age were predisposed to this congestion from want of contractile power in their abdominal parietes. Billings supposed that an exaggerated sensibility of the uterine nerves induced, in a reflex manner, spasms of the arterioles of the brain and kidneys, and so caused anæmia of these organs.

Franck believed the condition to be owing to secondary anæmia succeeding congestion of the brain, occurring in cows which had an easy and rapid delivery. The sudden contraction of the uterus and its diminished capacity, brought about by the post-partum pains, causes great disturbance in the blood-circulation. The organ receives much less blood, and this in ordinary cases is compensated for by the increased afflux to the mammæ and the skin; but a chill to the latter may upset this physiological compensation, and the repelled blood is diverted elsewhere; if this be to the brain, then there is cerebral congestion and consequent œdema, resulting in anæmia by compression of the bloodvessels. There is a predisposition to serous effusions in animals after parturition, because of the hydræmic condition of their blood, and especially when there is passive congestion of the kidneys and albuminuria towards the termination of pregnancy. The great frequency of cerebral hyperæmia in the cow was regarded by Franck as a consequence of the disposition of the arteries and the presence of the rete mirabile in the cranium.

The anæmic theory, however, does not explain the cases which appear before or during parturition, or some time after that event, nor does it account for the rarity of the disease after a difficult parturition.

It is believed to receive some support by the good results obtained by the distension of the mammary gland with air or oxygen. This distension may drive some of the blood from the mammary gland and increase the blood-pressure, relieving the anæmia.

3. **Derangement or Paralysis of the Nerve Centres.**—Many high authorities—among them, Köhne, Binz, Carsten Harms, Busch, Baumeister, Rueff—have maintained that the disease is primarily a derangement or paralysis of the ganglionic nervous system, which affects, or is extended to, the spinal cord and brain during the course of the disease. The following explanation is offered in support of this opinion: A too easy birth throws out of play a certain amount of nervous force destined to the accomplishment of this act. Hence there is a disproportion between the polar tension of the force conveyed by these nerves and the muscular irritability, and consequently an obstacle to the conductibility of the nerves charged with the distribution of this superfluous portion of the nerve force. Barlow thought that this disturbance in the function of the sympathetic nerves produces arrest of secretion and general congestion, especially of the brain and spinal cord.

4. **Alterations in the Constituents of the Blood.**—The opinion has been emitted that the collapse is due to an undue preponderance of water in the blood of some cows during the later stages of pregnancy, and that this results in cerebral anæmia after parturition. Another opinion is that the collapse is a kind of leucocythæmia, from the increase of white blood corpuscles in the blood during pregnancy and after parturition. But neither of these opinions can be reconciled with the symptoms or post-mortem features of the malady.

5. **The Presence of Something Abnormal in the Blood.**—The term "milk fever" was given popularly to the disease because it was believed to be caused by the absorption of the milk into the blood-circulation

Lafosse considered that the milky fluid (uterine milk) secreted by the cotyledons for the nutrition of the fœtus is no longer separated from the blood after parturition, remains in the circulation until it is eliminated by the mammary glands. If this material is not removed in that way, it accumulates and causes the symptoms of milk fever. There is nc evidence to support this theory.

Carsten Harms believed the disease to be an aeræmia, air having entered the uterine bloodvessels by aspiration after shedding of the placenta ; and in proof of this he asserts he detected the presence of air in the cerebral vessels. His observations have not been corroborated.

Abadie thought it was a mephitic poisoning, induced by the absorption into the blood of gases evolved in the stomach by indigestion ; while Hartenstein attributed the malady to absorption of certain matters formed in the muscular tissue of the uterus, and especially to the production of uric acid during parturition.

Ehrhardt considers parturient apoplexy to be a chronic auto-intoxication which becomes acute at the time of parturition. It is due to the retention in the animal economy of toxic substances produced during various organic changes.

Stockfleth, Lanzillotti-Buonsanti, Zundel, and Raynaud, have maintained the hypothesis that the absorption of septic matters formed in the uterus from the lochia, blood-clots, or tissue débris, acted upon the central nervous system, and produced the characteristic alterations that mark the disease. The uterus on post-mortem examination, however, is invariably normal in appearance. This theory was also supported by Schmidt-Mülheim in 1885. He believed that the disease was of toxic origin, and the toxin was generated from the albuminoid matters contained in the closed uterus. He likens the disease to botulism in man.

Numerous investigators—Trinchera, Nocard, Cozette, Conreur, and Pottiez—have tried to demonstrate the infectious nature of the disease. They have found numerous staphylococci and streptococci in the uterus, but failed to show any causal connection between them and parturient apoplexy.

Gratia in 1896 came to the conclusion that the disease was an intoxication of mammary origin. The disease is seen in good milkers during their best milking period and at the time of secretion of colostrum. It would seem, according to this view, that some toxins or leucomaines are produced by the glandular cells of the acini when they first become active. Some of these leucomaines are absorbed into the blood-stream, and certain symptoms are produced, varying in intensity according to the amount of toxin or leucomaine absorbed. It might be objected that these symptoms should also be produced in the calf when it devours the milk of the cow, but it may be that the laxative action of the colostrum prevents this effect, or that only by direct passage into the blood-stream is any serious effect likely to be experienced.

This hypothesis was adopted by Schmidt of Kolding, who has established a treatment of the udder which has been followed by wonderfully successful results.

It has been suggested that the toxin formed in the udder is of microbic origin, and, because of the success of the oxygen treatment, that the microbe is an anaerobe. There is no evidence to show definitely that the disease is due to an organism. Certainly the disease does not appear to be contagious.

Within recent years there has been an increasing tendency to incriminate the organs of internal secretion in the attempt to explain the development of milk fever. Two main theories have been put forward:

1. That the disease is due to *hypoglycæmia—i.e.*, a fall in the blood-sugar (glucose) content of the blood. It was first noted that a certain resemblance existed between some of the symptoms of milk fever in cows and those set up in the human subject by over-doses of insulin in the treatment of diabetes mellitus. Insulin is the hormone of the cell islets of Langerhans in the pancreas. By its action the amount of glucose in the blood is reduced, and the amount of reduction depends on the dose of insulin. Support was given to this theory by the work of Widmark and Carlens, who found that by inflating the udders of normal milch cows and goats a hyperglycæmia was set up, the intensity of which was greatest in the "deep milking" animals. Moreover, on inflating the udders of cows suffering from the disease these workers noted a rapid rise in the blood-sugar which coincided with recovery. Further evidence was provided by these authors and by Auger when they claimed by the injection of insulin to have produced in healthy cows an attack indistinguishable from one of milk fever.

This theory was altogether upset by the more recent work of Hayden and Fish, who demonstrated that there was no decrease in the normal sugar (glucose) in the blood during the course of this disease and that if any change occurred at all, there was a slight increase. They also showed that the temporary rise in blood-sugar following upon udder inflation was largely due to an influx of lactose from the mammary gland and this lactose was soon excreted in the urine.

2. The theory of *hypocalcæmia—i.e.*, a reduction of the calcium content of the blood. This theory appears to have its origin in the observations that there exists a striking similarity between the tetany of milk fever and tetany in the human

subject accompanied by a reduced calcium content, and that the symptoms of milk fever closely resemble those set up in animals experimentally by the removal of the parathyroids. That this reduction actually occurs has been shown by the observations of Little and Wright, by Dryerre and Greig, and others. Furthermore, the average fall amounts to 50 per cent. of calcium, and the fall actually runs parallel with the severity of the symptoms. This has been attributed to parathyroid deficiency, but against that view Pierre Fish has ascertained that the blood is also depleted of its phosphates, whereas in parathyroidectomized dogs the phosphate content is appreciably increased. He also showed that the recovery was accompanied more closely by the return of phosphates than calcium to the normal level. It has yet to be proved that the reduced calcium content of the blood is the causative factor and not merely an accompaniment of milk fever. Whatever the explanation of the reduction in calcium content of the blood, it may finally be observed that the cow suffers a very considerable loss of lime during pregnancy, and it has been estimated that in an average-sized cow the secretion of half a gallon of colostrum would be sufficient to deplete the blood of the whole of its lime if there were no reserve store of calcium to make this good.

Diagnosis.—**Parturient apoplexy** has been confounded with metritis and post-partum paralysis.

The symptoms of parturient fever and metritis or metroperitonitis, as we have described them, as compared with those of milk fever, differ so widely that a mistake should not be made if ordinary care be exercised. In metritis the temperature is raised, and there is no loss of sensibility and consciousness.

In post-partum paralysis the animal is conscious, often bright and attentive to its surroundings, generally free from fever, and eats and drinks as usual; the only symptoms usually noticeable being inability to get up, and to stand when raised. In mild cases of milk fever, however, one must remember that for a time after an animal is down it may remain conscious.

Prophylaxis.—A pregnant cow which is likely to be or has previously been affected with the disease should be treated to

reduce the predisposition to the disease. The animal should be allowed daily exercise, and her diet should be restricted, so as to prevent her from becoming very fat at the time of parturition. For this purpose she may be put on bare pasture during the latter half of pregnancy. A laxative both before and after calving is also recommended.

Within recent years an entirely new conception regarding the method of feeding cows to prevent milk fever has been advocated by Boutflour. He recommends what he calls a "steaming up" process for a few weeks before calving as a preventative for milk fever. This consists in feeding large quantities, as much as 15 pounds per day, of concentrated food, particularly palm kernel cake, and limiting voluminous food such as hay. Boutflour goes so far as to state that instead of heavy feeding with concentrates causing milk fever it is the best means of preventing it. It may also be remarked that he drenches the cow, under this "steaming-up" process, with ¾-pound of Glauber salts the day before it is thought that the animal may calve and repeats the drench after calving.

Sahlmann and Dommerhold, district veterinary surgeons in Germany and Holland respectively, hold that after calving just as much milk should be drawn from the udder as is required for the calf, and further milking abstained from. Dommerhold reports excellent results from the practical preventive measure of limiting milking, after calving, to the needs of the calf. If any suspicious symptoms arise, or if there appears to be any likelihood of an attack after parturition, it has even been advised that the udder should be inflated at once with air or oxygen.

Curative Treatment.—Many and varied were the older methods of treatment advised in this disease. They included large doses of purgatives, stimulants, narcotics, the application of counter-irritants to the spine, venesection, cold applications to the head, etc., but they have all been abandoned since the introduction of udder injections by Schmidt of Kolding in 1898. This Danish veterinarian, accepting the views of Gratia on the etiology of milk fever, sought to counteract the production of the poisons in the udder and their action by intramammary injection of an aseptic solution of iodide of potassium. In a

litre (1¾ pints) of water boiled for fifteen minutes, he dissolved 7 to 15 grammes (2 to 4 drachms) of iodide of potassium (according to the size of cow). This solution was kept lukewarm, and 250 c.c. (one-fourth of the whole) was injected into each quarter. The simplest apparatus for practising this injection consists of an india-rubber tube, 4 or 5 feet long, to which a teat siphon is fixed at one extremity, and a metal or glass filler at the other. The operator inserts the teat siphon into the teat duct, and, holding the filler 2 or 3 feet above the udder, pours the fluid into the latter. The fluid quickly passes into the udder. Other apparatus used comprises india-rubber and metal syringes.

This injection must be given with scrupulous attention to surgical cleanliness, in order to prevent mammitis. The mammary gland is first emptied completely of milk, and the teats and the udder in the neighbourhood are washed with an antiseptic lotion, such as 2 per cent. lysol. The hands of the operator must also be washed with the antiseptic. The apparatus used, the vessels containing the fluid, must also be washed with boiling water. The india-rubber tube is best immersed, for thirty minutes previous to use, in a solution of 5 per cent. carbolic acid or 3 per cent. boric lotion. These agents do not damage the rubber. Immediately before use the antiseptics are washed out of the tube with boiled water.

After the injection the mammary gland is massaged to cause the diffusion of the fluid throughout the udder.

This treatment caused a considerable decrease in the mortality. Afterwards other agents, such as chinosol (30 to 60 grains to a quart of water), were used, with equally good results. It was noted also, by Schmidt and others, that the patients recovered more rapidly and more certainly if a little air were injected with the liquid into the udder. Gradually the fluid injections have been entirely replaced by inflations of the udder with air or oxygen, with considerable improvement in the result, until now the mortality under treatment has fallen to a few units per cent. Andersen of Scanderberg was the first to use atmospheric air to distend the udder.

The details of present-day treatment are as follows: A teat siphon and an ampulla containing sterilized cotton-wool adapted to an india-rubber syringe are the only instruments

necessary. The operation must be carried out as aseptically as possible, to prevent infection of the udder. Boil the instruments in water or immerse in 5 per cent. boric lotion before use. Then fill the ampulla with aseptic cotton-wool. The cotton-wool is used in order to act as a filter to the air before the latter is introduced into the gland. Disinfect the mammary gland and teats. Insert the teat siphon and inflate all the quarters of the udder to a state of firm distension. Then apply a broad piece of tape, with moderate pressure to each teat to prevent the escape of the air. The pressure must not be so great as to cause damage or necrosis of the teat, and the tapes must be removed in two or three hours. Massage the udder, to cause diffusion of the air through the gland.

Then make the animal comfortable. Insist upon plenty of soft bedding to prevent bedsores, and with the same object turn her from one side to the other every three or four hours. Keep the cow propped up on her sternum with a truss of straw or bags stuffed with hay or straw, to prevent tympanites. If she is tympanitic even in this position, puncture the rumen with a trocar and cannula to remove the gas. Remove the fæces from the rectum, and, if necessary, the urine from the bladder. Generally the insertion of the finger into the urethra is sufficient to effect the latter object. On no account should drenching be permitted when the cow is comatose, so as to avoid any chance of foreign body pneumonia. No other medicine is as a rule necessary. If the coma is very deep, injections of stimulants, such as $\frac{1}{2}$ to 1 grain of strychnine or 20 grains to 1 drachm of caffein, may be given.

The patient recovers after this treatment in from two or three to twenty-four hours. In a few cases it is necessary to repeat the inflation of the udder in six or eight hours. For the inflation, oxygen injected direct from a cylinder may be used instead of air.

After recovery the cow should be kept on half-rations for a few days. Lactation in a short time returns to its normal proportions.

In cases where the urgent symptoms have disappeared, and the animal appears normal save that it can not or will not rise, nerve and general stimulants, such as strychnine or nux vomica and ammonium carbonate, should be administered, and

the limbs massaged. The introduction of the calf or a dog into the stall is often sufficient to bring the cow to her legs. Sometimes it is necessary to raise her bodily before she will give any assistance, but then after a few minutes she begins to throw her weight upon the limbs, and is soon able to stand and move on her own account. These cases seem to be due to cramp of the muscles of the limbs from lying too long.

In the ewe and goat a condition apparently identical with milk fever in cows has sometimes been seen which responds readily to mammary inflation with air or oxygen.

POST-PARTUM PARALYSIS.

Paralysis after parturition may be occasionally noted in any of the domesticated animals, but is most frequent in the cow. It is much less common than ante-partum paralysis.

Of the *cause* and *pathology* of the condition little is known. Harms and others thought it was due to injury inflicted on the sacral and other nerves during difficult parturition. The obturator, crural, and sciatic nerves are particularly liable to injury. Post-mortem examination, however, has only furnished negative evidence of this. Franck thinks that injury to the cervix uteri may give rise to reflex paralysis; this has been witnessed in the bitch. Prolonged arrest of the foal in the passage is a common cause of post-partum paralysis in the mare.

In some cases the spinal cord has been found injured, and its vessels congested with blood-clots in the spinal canal; and in others the roots of the abdominal nerves have been surrounded by serous effusion.

It may also be due to injury or sprain of the pelvic ligaments.

Symptoms.—The symptoms are similar to those of ante-partum paralysis, and appear immediately or shortly after parturition.

The animal continues to lie, and one or both hind-limbs may be moved in a convulsive, irregular manner, or they are completely incapable of movement. In the majority of cases the animal is able to turn itself over at intervals from side to side, particularly during the night. Sometimes only one leg

is paralyzed. Sometimes the limbs may be moved about readily, but the patient will not even attempt to get up; its appetite is unimpaired, it exhibits no symptoms of disease or suffering, but yields plenty of milk, and the excretions are normal. This condition may continue for weeks or months, and often animals have to be killed in consequence of it.

Diagnosis.—There should be no difficulty in distinguishing this condition from parturient apoplexy, metritis, or other affection incidental to parturition. In inflammation of the spinal cord and the meninges, there is not only loss of power, but diminished sensation of the limbs, fever, and pain manifested on manipulation over the loins. If it is due to sprain of the back from slipping, then sensation is not impaired, and pain may be indicated on pressure of the part injured.

In examination of the patient, the limbs and pelvis should be carefully inspected to negative injuries or fractures. The pelvis should be examined *per rectum*, and for crepitation during movement.

Prognosis.—Sometimes recovery takes place in a few days, but if decubitus persists after a week the case is a very serious one, and is frequently fatal. If the animal can remain standing when got up, for ever so short a time, it will in all probability recover, though it may be lame in one or both limbs for a considerable period.

Treatment.—The patient must be made comfortable. The bedding must be soft and thick. If the animal does not turn of its own accord, this should be done by its attendants twice or three times a day. It is very important to lift the animal as soon as that is possible. Slinging for a short time every day is of considerable service. In these ways bedsores may be avoided. The bowels should be unloaded by a laxative, and stimulants, such as strychnine or nux vomica and the ammonia compounds, administered. A blister or counter-irritant, such as mustard, may be applied along the spine. If necessary, the urine may be drawn off at intervals. Massage of the limbs is useful. Galvanism may be tried. In all cases the state of the uterus should be ascertained; and if it is unsatisfactory, then remedial measures should be adopted with regard to it.

PARTURIENT ECLAMPSIA.

Eclampsia is an acute condition which is associated with tonic and clonic spasms or convulsions, usually without loss of consciousness. It is sometimes observed after, occasionally before, parturition in the mare, cow, ewe and goat, bitch and sow.

Symptoms.—In the mare, the disease has been seen by Williams of America. It appears in strong mares in good condition, which have foaled easily a few days previously (eight to fifteen days is a common period). The foal is healthy and suckling, and the mammary glands are normal. The mare has usually been at pasture, but a short time previous to the attack is taken into the stable or box. The symptoms appear suddenly, and develop frequently within a few hours. The mare becomes very nervous, anxious, and restless ; her eyes are staring, twitching of the muscles occurs, and the animal appears very stiff. Clonic spasms set in. Later she is unable to get up, and during the spasms lies on her side, with the muscles rigid. The pupils are dilated, the mucous membranes are livid, the breathing is laboured, perspiration becomes profuse and general, and there is distinct trismus. Manipulation or approach by strange attendants brings on the spasms. Within one or two days, the animal recovers rapidly or dies. Death results from asphyxia. In this disease there is no protrusion of the membrana nictitans, as in tetanus, and no discoloration of the urine, as in azoturia.

It is interesting to note in this connection that a similar, if not an identical, condition is described under the heading of tetany by Montgomerie, Savage, and Harvey in Great Britain. This disease readily yields either to intramammary or subcutaneous injections of air. It appears to affect chiefly ponies, and has been observed for the most part in suckling mares soon after being housed, or in ponies of either sex which have just completed a journey by rail. The chief symptoms noted are : sweating, general stiffness, a stiff, jerky gait, short step, accelerated respirations, dilated nostrils, and distinct trismus. The membrana nictitans is not protruded and the temperature is normal. The calcium content of the blood is very low. The mortality is high in untreated cases.

In the cow, eclampsia is described by Professor Mauri, by Calmette, Lafitte, and Clarke. The symptoms described correspond very closely with those observed in the eclamptic form of parturient apoplexy. The disease is said to occur at all ages, and may appear occasionally before parturition, but is most frequently observed after that event, and soon, although it may be delayed as long as the twenty-sixth day.

Primiparæ often suffer, and it is said to be most frequently observed in cows in poor condition. When it attacks the cow ante partum, it is believed to be usually about mid-term, and convalescence and recovery may follow without labour being induced.

In the cases reported by Clark, the attack was usually sudden, and without warning, though the cows had not been altogether well for a day or two previously. The symptoms were—"foaming at the mouth, champing of the jaws, prominent staring eyes, excited expression, head very often turned to the side; sometimes licking at the fore-leg, stall, or some imaginary object. Some cows I have heard bellow, others do not do so; there was twitching of the body and limbs (clonic spasm), difficulty in respiration, according to the intensity of the attack. The convulsions generally last two or three hours, and in the majority of cases do not reach the stage of coma, although I have had cases which have done so." Two or three attacks may occur within twenty-four hours. The urine may contain albumin. The prognosis is favourable if proper treatment is timeously adopted. Occasionally an animal dies from asphyxia. Clark reports a case which became blind after remaining recumbent for a month after the attack.

In ewes and goats the disease has been reported by Lafitte and De Bruin. It occurs usually after parturition. There are at first convulsions of all the muscles, particularly those of the jaws, rolling of the eyes, salivation. During the convulsions the animal cannot stand. Later coma sets in. It is possible that this condition is similar to milk fever in the cow. The prognosis is good.

Puerperal or parturient eclampsia has been observed most frequently in the bitch. It was first described by Hertwig. It is noted in bitches which are suckling, and particularly

those kept in the house and well fed. Bitches of the miniature breeds are very subject to an attack. The disease usually appears from two to eight days after parturition, rarely as late as fourteen or thirty days, seldom before birth. Occasionally it occurs after removal of the puppies. The animal suddenly commences to be uneasy and anxious; the eyes are haggard, sometimes the nose is a little hot; the respirations are very short and quick, though pressure on the chest or abdomen does not cause any pain. In a short time, about a quarter of an hour after the difficulty of respiration was observed, the animal cannot stand, but falls on its side, and lies with the limbs extended, due to tonic spasms of the muscles of the body; even when raised it cannot stand. The breathing becomes still quicker—from sixty to one hundred per minute—while the pulse is small, hard, and irregular. Clonic spasms extend rapidly over the whole body; sometimes there is trismus, with grinding of the teeth; constantly there is a white foam at the mouth and muscular tremblings of the jaws. The mucous membranes are cyanosed, consciousness usually remains, the animal refuses food and drink, and the alvine and urinary excretions are suppressed. The mammary glands are at first greatly engorged, hot, and abundantly provided with milk, which the puppies frequently continue to remove as before, but later they become flaccid and empty. The urine contains albumin.

There are cases in which the eclampsia appears to be partial, affecting only the hind-limbs, for instance, and the animal sits, the head being unaffected, and whines.

The course of the disease is acute, and lasts most frequently one or two days, occasionally a few hours. Sometimes the attack is repeated on one or more occasions at intervals of a few hours. As many as six attacks have been noted in the course of a day.

Lafitte saw a bitch which had given birth to two puppies two days previously, and which it was suckling; it had an attack of eclampsia that continued for a day, another of shorter duration on the following day, and a last and slight one the next day. The bitch recovered, but some days afterwards the puppies had a similar convulsive seizure, less intense and shorter in duration. One had three attacks on

the first and second days, and died; the other had only two in the one day, and survived.

The prognosis is good when the disease is promptly handled. Death may result from asphyxia or apoplexy.

In the sow, eclampsia has been observed by Ellenberger, Wöstendorf and Seiler in North Germany, and by De Bruin and Hegel. It appears in from three to five days after easy parturition. The symptoms consist of loss of appetite, neglect of the young, persistent lying, suppression of fæces and urine, diminution or cessation of secretion of milk. The animal lies on its side, the eyes closed, grinds its teeth, becomes affected with spasmodic contractions of various groups of muscles. The respiration is irregular, deep-drawn, and moaning; there is great loss of sensibility.

After twenty-four or thirty-six hours improvement takes place, fæces are voided, the animal pays attention to surrounding objects, the breathing becomes normal, and in from three to five days recovery is complete and is the rule.

Etiology and Pathology.—The cause of the disease is obscure. There are no definite lesions observed post mortem.

Scanzoni, Dubois, and others, believe the disease in the human subject to be a neurosis due to reflex irritation of the spinal nervous system. Traube and Rosenstein ascribe the occurrence of eclampsia to acute cerebral anæmia, due to changes in the blood during pregnancy.

It may be due to retention of effete products in the system during pregnancy. In the bitch the disease has been attributed to chills, loss of offspring and consequent stagnation of milk, and mental emotion, but these alleged causes have not good evidence in fact to support them. Clark firmly believed that the primary cause, especially in post-partum cases, is reflex irritation of the uterine nerve centres, basing this belief on his observation that the attacks in the cow occur most frequently from the eighth to the twelfth day after calving, this being the period at which the "second cleansing" appears. In all his cases the weather was unfavourable, being cold and stormy, with east and north-east winds, and this, in his estimation, was a potent factor, causing chill, which, acting directly on the nerve centres of the uterus, produces reflex irritation of the spinal system, which again causes albuminuria.

Treatment.—In all cases the animal must be kept quiet and comfortable. The offspring may be left with the dam. Free abstraction of blood from the jugular vein is recommended in the larger animals, and excellent results have been obtained. Sedatives should be administered. The extracts of belladonna and cannabis indica have been used with success in the mare and cow. Clark regards belladonna as almost a specific, in doses of from 2 to 3 drachms of the extract, repeated in two or three hours if necessary. In the smaller animals drenches should be avoided, because of the danger of choking. Morphine hydrochloride, in 0·3 to 0·6 grain doses to the bitch, may be administered hypodermically, and repeated in a few hours if necessary. Bromide of camphor is favourably spoken of, as well as chloral hydrate enemata or chloroform or ether inhalations. To relieve the constipation, ordinary enemata may be employed. To the sow, De Bruin recommends the administration of an electuary composed of magnesium sulphate 10 grammes, powdered anise-seed 50 grammes, and common syrup, placed on the tongue and given in one day. In the larger animals inflation of the udder should be tried as in the treatment of milk fever.

PARTURIENT LAMINITIS.

Inflammation of the sensitive laminæ, or laminitis, is sometimes observed in the mare a few days after foaling or abortion. Obich asserts that it and metritis are the most frequent sequelæ of parturition in the mare. It appears to have been first described by Tisserant, in 1846; since then it has been alluded to by Gloag and Smith, by Fabry, Deneubourg, Obich, Ayrault, and others. A similar condition in the cow has been described by Roloff, Bedel, Dumand, and Lucet. In some cases in the bovine the claws have been shed.

Symptoms.—The symptoms of the disease are those of laminitis occurring under ordinary conditions. They are suddenly manifested on the second or third day after foaling or abortion, more rarely on the fourth day, and very seldom later. In a small number of cases, inflammation of the feet has been noticed either during or immediately after parturition. Exceptionally it has taken place within twenty-four hours after

the contents of the uterus have been expelled. As a rule there has been nothing remarkable in the case, birth having taken place naturally; sometimes, however, parturition may have been difficult. It may be a complication of metritis in the mare, and has been observed also as a complication of ruptured vagina.

The attack is usually sudden. Occasionally it commences with loss of appetite; depression; great thirst; hurried respirations; full, hard, and quick pulse; fever; constipation—premonitory symptoms which may continue for two, three, or four days. The fore or hind feet may be affected; in some instances all the feet may be involved. The position of the animal, if standing, indicates the feet affected, and they are found to be extremely hot, the plantar arteries throbbing, and percussion of the hoof causes intense pain. During the inflammation the mare evinces the greatest agony. If all the feet are implicated, standing may be impossible; the expression is anxious and pinched; the respiration is hurried, jerking, and plaintive, and the nostrils widely dilated; the skin is usually covered with perspiration, and the production of milk is completely checked. The mare takes not the slightest interest in the foal. The rapid disappearance of the secretion of milk has attracted the attention of nearly every observer. In the evening, perhaps, there will be an abundant supply of milk, and in the morning emulsion or suction will only obtain a few drops of a transparent or reddish fluid, though the mammæ may look as full and as well developed as usual. The suppression of its supply of food is soon testified to by the foal, which betrays its sensation of hunger by becoming less timid and making itself familiar with those around. Occasionally the symptoms may be masked by, or may themselves mask, those of metritis.

The *duration* of the disease is from four to eight days. The symptoms are certainly most intense between the fourth and eighth days. The termination is generally recovery, if proper treatment has been adopted, though in some cases the malady assumes a chronic form, with the accompanying deformity and disorganization of the feet. In rare instances death may ensue from nervous exhaustion caused by the excessive pain; or the inflammation may run on to suppuration, and a fatal

result arise from pyæmia, with abscesses in the lungs, brain, or other organs.

A favourable or unfavourable prognosis may, according to Guilmot, be gained from a lacteal secretion. If this returns in the course of a few days it is a good sign.

Causes.—The cause or causes of parturient laminitis are imperfectly known. Tisserant believed that it is due to a disturbance of the functional equilibrium existing between the various organs. After parturition, and particularly after abortion, there is manifestly a disturbance of this kind: there is a general superabundance of blood, and consequently a tendency to disease until the equilibrium between production and consumption is restored. Deneubourg is inclined to think that the morbid localization is due to sudden suppression of the lochia. Lucet remarks that the disease always coincides with the suppression or diminution of the lochia after parturition. Bouley was of opinion that parturient laminitis may be allied to that other form which so commonly succeeds intestinal congestions from accidental causes or from drastic purgatives; and that both varieties may well be the result of a momentary paralysis of the vasomotor nerves of the keratogenous apparatus of the foot, under the influence of a profoundly depressing action. According to Jougan, the chief cause of the condition is retention of the fœtal membranes. The circumstances preceding the condition point to some form of septic infection from the uterus.

Treatment.—In the treatment of this disease, the rules observed in the ordinary attacks of laminitis are usually applicable.

In the majority of cases the treatment need not and should not be heroic.

The inflamed feet should be treated with the greatest care, and for subduing the inflammation nothing can equal cold applications—either cold water, cold poultices, or even ice. Continuous irrigation is to be preferred, the water being applied by means of india-rubber tubing, which carries the fluid direct from the water-tap to the foot. The latter is thickly covered with pieces of thick flannel or tow, so as to diffuse the water around it. The shoes should be previously removed, and the wall of the hoof lowered, so as to allow the

sole and frog to sustain as much of the weight as possible. It is a good plan to litter the animal on sawdust or peat-moss. This is especially necessary if the animal is recumbent and unable to rise. When suppuration is apprehended or has set in, or even when effusion or exudation is serious, an outlet may be made between the sole and the wall, towards the toe of the hoof, for the escape of the fluid. Astringent and antiseptic lotions or footbaths may be useful.

The diet should be light, and limited to mashes, gruel, grass, a small quantity of good hay, and chilled water. The body should be comfortably, if not warmly, clothed, and friction to the skin is often beneficial.

If constipation is present, laxatives should be administered, and emollient enemas are most useful. Arecoline hydrobromide is now frequently employed in the treatment of laminitis. One-half to one grain is given hypodermically daily for three or four days.

The uterus should be attended to, any remains of the fœtal membranes, if present, removed, and irrigations of sterilized water and mild antiseptic lotions, as in metritis, carried out at intervals.

The foal should be allowed to remain with the mare, as its frequent sucking is likely to hasten the return of the milk, which is, as has been already remarked, a most favourable sign.

TETANUS.

Tetanus has been occasionally observed in the cow and ewe after parturition, especially after manipulations have been carried out in prolapse of the uterus, retention of the fœtal membranes, and difficult parturition. The infection may in these cases be introduced by the hands and instruments of the operator.

The symptoms and treatment are similar to those of tetanus in other conditions.

ACETONÆMIA OF CATTLE, POST-PARTURIENT DYSPEPSIA.

Acetonæmia is a disease which is seen in cows of a good milking type, usually within a few weeks after calving, occasionally after a few months, and at the period when they are

most prone to milk fever. It is noted when the animals are in the house. The cause has not been definitely ascertained. It has been variously attributed to the absorption of the aseptic lochia in the uterus, to the feeding on too highly concentrated diet, and the absorption of toxic products from the alimentary canal. Whatever be the exciting cause, it seems to be connected with the appearance of acetone and acetone compounds in the blood setting up an acidosis, and their excretion in the expired air from the lungs, in the urine, and in the milk. That phenomenon would suggest the incomplete oxidation of fats and proteins in the tissues.

The symptoms develop slowly. At first the appetite becomes poor and rumination is irregular. The abdomen becomes empty looking and constipation is observed. The temperature is normal or subnormal, the pulse is slow, and the respirations infrequent. A very pronounced feature of the disease is the peculiar, sweet, acetone-like, sickly odour which is appreciable in the cowshed, and can be recognized in the urine and in the milk, especially when the latter is warm, by the very special odour given off. Chemically the acetone in the urine or milk may be detected by Lieben's iodoform reaction or Legal's sodium nitroprusside test.

In some cases of acetonæmia, nervous phenomena develop, especially when the patient is tempted with rich food. The animal appears listless and staggers in its gait, or may salivate and grind the teeth, show spasms of various muscles or become affected with fits.

The course of the disease varies from a few days to a few weeks. In serious cases the animal loses condition rapidly, and when the disease is fatal death occurs from inanition. Occasionally foreign body pneumonia has been noted from indiscriminate drenching.

Treatment consists in giving a purgative such as salines combined with aloes, followed by alkaline bicarbonates and tonics. The alkalies may overcome the acidosis. A laxative, easily digested diet is also indicated. Where nervous phenomena appear, mammary injections of air or oxygen should be resorted to.

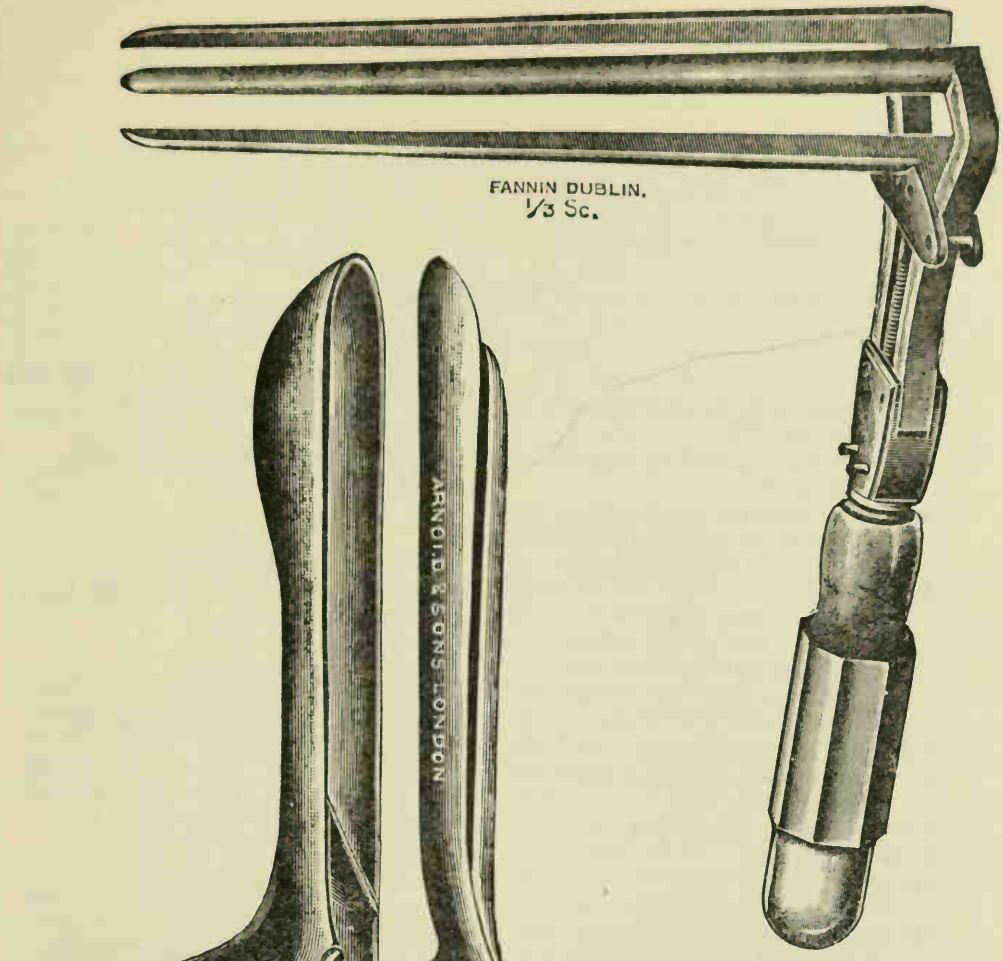

FIG. 168.—VAGINAL SPECULUM FOR COW (*see page* 68).

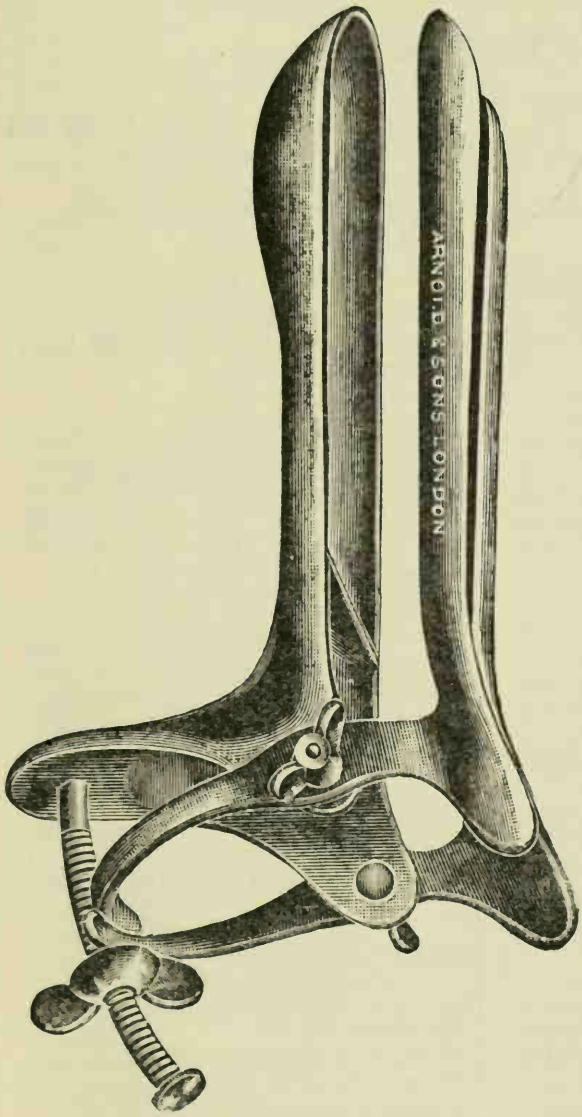

FIG. 166.—VAGINAL SPECULUM FOR THE MARE (*see pages* 68 *and* 74).

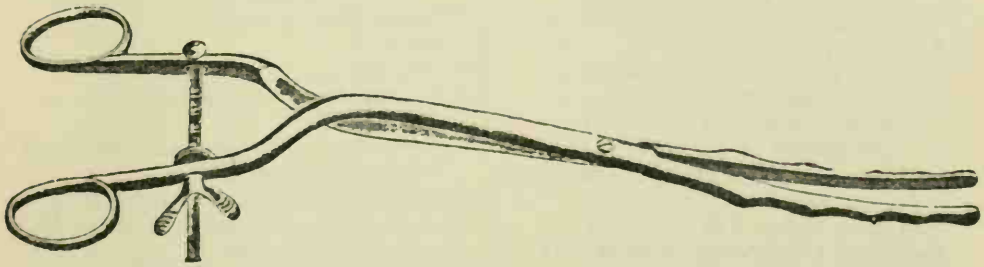

FIG. 167.—UTERINE DILATOR FOR THE COW (*see page* 258).

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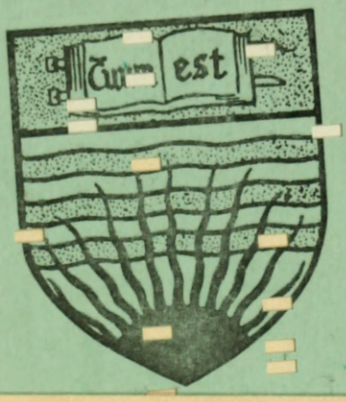

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